April 22, 1957 50 Cents

AVIATION WEEK

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Engineer-Pilot Describes IL-14

TWA's Lockheed 1649A Jetstream

Air Transport Facts and Figures

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AVIATION CALENDAR

Apr. 23—Missile Session New York Section, Association of Electrical Engineers, 7:30 p.m. 33 W 39th St New York, N Y

Apr. 23-25—International Symposium on Role of Solid State Phenomena in Electrical Circuits, Engineering Societies Bldg N Y C

Apr 23-25—Annual Convention International Airline Navigators Council Piccadilly Hotel, New York

Apr 24-25—National Industrial Research Conference Conrad Hilton Hotel Chicago Ill

Apr 29—Third Flight Test Instrumentation Symposium Statler Hotel Los Angeles

Apr 29-May 2—16th Annual National Conference Society of Aeronautical Weight Engineers Broadview Hotel Wichita

Apr 30—Atlantic Rate Commodity Rate Board Meeting International Air Transport Assn, Torquay Devonshire England

Apr 30—Electronics Make the Helicopter Fly annual section meeting New York Section American Institute of Electrical Engineers, 33 W 39th St, New York

May 1-3—Spring Meeting and Exhibit Society for Experimental Stress Analysis Hotel Statler Boston, Mass

May 2-3—Annual Meeting Aeronautical Training Society Mayflower Hotel Washington D C

May 2-4—Spring Meet National Intercollegiate Flying Assn, Oklahoma A&M College, Stillwater Okla

May 3-5—Seventh Aviation Education Conference San Jose State College San Jose, Calif

May 5-8—1957 Convention American Association of Airport Executives Shamrock Hilton Hotel Houston Tex

May 6-8—28th Annual Meeting Aero Medical Assn Shirley Savoy Hotel Denver

May 7-9—Electrical Engineering Aspects of Aircraft and Missiles American Institute of Electrical Engineers, Biltmore Hotel Dayton, Ohio

(Continued on page 6)

AVIATION WEEK • APRIL 22, 1957

Vol 66, No. 16

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AVIATION CALENDAR

(Continued from page 5)

May 7-9—Spring Assembly, Radio Technical Commission for Aeronautics, Ambassador Hotel, Los Angeles, Calif.

May 7-9—East Central & Middle Eastern District Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Dayton-Biltmore Hotel, Dayton, Ohio.

May 8-11—13th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 13-15—National Conference on Aeronautical Electronics Sponsored by the Institute of Radio Engineers, Dayton, Ohio.

May 14—Engine Operation & Maintenance Forum, sponsored by Pratt & Whitney Aircraft Division and distributors, Pacific Airmotive Corp., Cosmopolitan Hotel, Denver, Colo. Other sessions, May 17 at Ambassador Hotel, Burbank, Calif.; May 20 at Hotel Claremont, Oakland, Calif., and May 22, New Washington Hotel, Seattle, Wash.

May 15-17—Jet Age Airport Conference, Air Transport Division, American Society of Civil Engineers, Park Sheraton Hotel, New York.

May 20—Sixth Annual Aviation Fire Safety Seminar, National Fire Protection Assn., Hotel Statler, Los Angeles, Calif.

May 20-23—Design Engineering Show and Second Annual Design Conference sponsored by Machine Design Division, American Society of Mechanical Engineers, New York Coliseum, N. Y.

May 23—Guenter Loeser Memorial Lecture, "Progress & Prospects of Radar Meteorology," Dr. David Atlas, Charter Rm., New England Mutual Bldg., Boston.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, LeBourget Airport, Paris.

June 1—8th Annual Maintenance and Operations Meeting for Business and Executive Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 1-9—First Annual National Aviation Trade Show, Monmouth (N. J.) Airport.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

June 24—Soviet National Aviation Day, Moscow.

July 12-13—British Lockheed International Acrobatic Competition, the National Air Races (third round) and the King's Cup Air Race, Coventry Civil Aerodrome, Bagington, England.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Sept. 1-6—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Nov. 7-8—Weapon Systems Management Meeting, Statler Hilton Hotel, Dallas.

Dec. 17—Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

Graph-Mo® dies cut downtime 50% on deep draw for round vacuum cleaner!

ENGINEERS at The Hoover Company had a tough problem in getting that round vacuum cleaner shape in the new Constellation. The two circular dies that form the hemispheres often galled, picking up bits of the steel being formed. This scored the dies, marred the finished parts. Production had to be shut down while the dies were repolished. And extra polishing of the hemispheres ran up costs still more.

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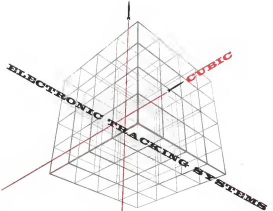

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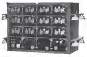
For missile checkout, flight tracking experimental aircraft and missiles, the TDI systems are highly effective, even under the most severe field service conditions. They operate ideally with tape recording, oscillographic, photographic and similar types of recording equipment . . . and this rugged equipment can be installed in jeeps, autos and trailers.

Design-wise, these systems achieve substantial reductions in weight, size and power consumption—yet a high degree of accuracy, exceptional stability and simplicity of operation are maintained.



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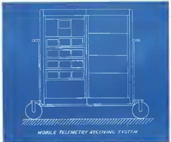

← Telemetering on wheels! New portable test cart enables users to perform wide variety of telemetering functions in previously inaccessible locations, with greater efficiency and accuracy than ever before.

Technical bulletins on miniature receiving systems and other TDI products available on request.

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Sperry radar test set rides early warning picket ships

AN/UPM-44B unit checks S-band radar in flight

Checking the performance of search radar aboard Navy WV-2 and Air Force RC-121D radar planes is the job of the Sperry AN/UPM-44B combination test set. While these Lockheed Super Constellations patrol both coasts 24 hours a day, their radars are constantly monitored by AN/UPM-44B test equipment to assure peak efficiency at all times.

Developed by Sperry in cooperation with the Navy's Bureau of Aeronautics to meet all requirements of MIL-T-945A, this new S-band test set combines in a single unit the multiple functions of a frequency meter, power meter, signal generator, spectrum analyzer and synchroscope.

Compact and portable, the AN/UPM-44B provides direct reading of peak or average transmitted power and frequency. It instantly detects any deterioration in performance, and pinpoints the source of trouble for crewmen to take corrective action. Sensitivity, stability and bandwidth measurements are made with pulse or frequency modulated signals produced by the test set. A gating circuit permits spectrum analysis of any selected pulse from a multi-pulse system.

Write our Microwave Electronics Division for additional information covering test sets in the frequency range of 400 mc through 40,000 mc.

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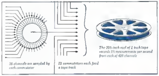
MAGNETIC TAPE APPLICATIONS BY AMPEX
2

How to record 420 channels of simultaneous data

Boeing Airplane Company's flight tests demonstrate an easy way

Have you ever seen an oscillograph record that was eight and a half feet wide? At fifty channels per foot this is what it would take ... which shows the decided advantages in the way the Boeing Airplane Company solves the problem. They put 420 channels of data onto a one-inch magnetic tape. Two hours of flight test can be recorded on one 10½-inch reel.



In a published article, Mr. Arthur T. Snyder of Boeing describes their system as a low level, low-speed, pulse-width-modulation technique. It time-multiplexes 35 channels of data onto each of 12 tracks (of 14) on an Ampex 814 Airborne Magnetic Recorder, (35 × 12 = 420). The system inputs are variable resistances, thermocouples, strain-gage bridges and other bridge-type transducers. Each is fed to a segment on one of twelve rotating commutators that sample every channel 2½ times per second. The Ampex 814 recorder running at 3¾ in/sec. records over 8-million measurements in two hours.

This recording system used by Boeing is limited *by choice* to data that changes at a slow rate. This is by no means a fixed limitation. Certain Ampex recorders (Series 800, FR-100 and FR-1100) have interchangeable amplifiers. Each track can thus be used with any one of three types of recording according to frequency requirements.

With PWM recording (like the Boeing example) as many as 88 channels of low-frequency data can be put onto one track.

With direct recording up to 18 channels of RDB subcarrier data of varying frequency requirements can go onto one track — or very high-frequency data uses one track per channel.

With FM carrier recording one channel of data occupies one track and provides high instantaneous amplitude accuracy. FM is particularly suitable for shock and vibration records.

When a recording containing a large number of channels of data is reproduced, another of magnetic tape's advantages becomes apparent. The data can be reproduced in electrical form. Consequently it is a relatively simple matter to unscramble the channels by automatic or semi-automatic means. Any combination of channels can be scanned, correlated and fed to computing devices. These fortunate faculties of magnetic tape help reduce the handling of vast amounts of data down to a task of wieldy size. For example in the Boeing flight tests already mentioned, all data is published within two or three days after the test instead of from several weeks to several months later as by previous methods.

Boeing KC 135 tanker in flight

If you have a specific problem involving large amounts of data or unusual combinations, Ampex's application engineers will be pleased to furnish further information. More of the capabilities of magnetic tape will be discussed in this continuing series of bulletins. Would you like to have copies mailed direct? If so, write Dept. UU-4.

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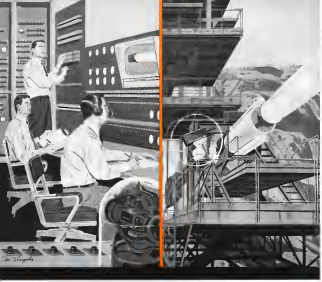

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APRIL 22, 1957

AVIATION WEEK

VOL 66, NO 16

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COVER First in-flight photo of Trans World Airline's initial Lockheed 1649A 'Jetstream' scheduled for delivery to the airline this week It will go into airline service July 1 Wing of Super Constellation has been lengthened to 150 ft in 1649A and propeller diameter is increased to 16 ft. However, tip speed is lower to provide less cabin noise Nacelles also have been moved outboard from fuselage

Picture Credits
64—Sovfoto, 127—Wide World

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AVIATION WEEK • APRIL 22, 1957 • Vol 66 No 16
Member ABP and ABC

Nuclear Storm Clouds Gather

International events of the past few weeks have seen a pronounced drift toward an eventual showdown between the U.S. and the Soviet Union in the diplomatic maneuvering of nuclear sabre rattling. Both of these nations now possess the capability of large scale nuclear attack to bolster their claims of massive retaliatory force to be applied against any breaker of the uneasy peace that now grips the world. So it is small wonder that allies in both camps and neutrals are becoming increasingly uneasy over this situation.

Perhaps the most important development is the virtual abdication of Britain as a prime military power in the nuclear era. Defense Minister Duncan Sandys has made it clear that Britain is abandoning the primary responsibility for its own defense and placing paramount reliance upon the nuclear warfare capability of the U.S.

This is a bitter pill for proud Britons to swallow. But it is a decision dictated by considerations of purse rather than pride. The sad truth is that Britain can no longer afford the costly investments required for research and development of modern weapon systems required by the supersonic nuclear era. Britain was already lagging badly in this development race before its government acted to relieve itself of the costly nuclear airpower effort.

In effect, Britain is gambling that there will be no major war for another three to five years. For it will be at least this long before the 1,500 mile range guided missiles that it hopes to get from the U.S. will be produced and delivered abroad in sufficient quantity to constitute a genuine retaliatory threat to potential enemies within this range on the European continent. The Douglas Thor missile being developed under USAF sponsorship is still in the early experimental development stage as is its possible alternate, the Army's Jupiter developed at Redstone Arsenal.

This is the second time since the end of World War II that the British have taken a calculated risk on their aerial weapons development program to save a large slice of money. At the end of World War II, British weapons policy was predicated on the gamble that there would be no major war again for at least 10 years. The air power development program was aimed at skipping a generation of new weapons and jumping directly to the high subsonic fighters and bombers that were scheduled to be in service by 1955. In the meantime, the Royal Air Force was forced to make do with the relatively low speed, straight winged Vampire and Meteor jet fighters that were developed during the closing phase of World War II.

Outbreak of the Korean war in 1950 proved the British planners had made a bad guess. The Royal Air Force had no jet fighters capable of matching the sweptwing Russian MiG-15 that appeared over Korea late in 1950. The burden of air defense of the United Nations coalition fell upon the USAF F-86 Sabre jet, where it lay heavily for the next five years. Only those fighter pilots and war correspondents who were at Kimpo and Suwon airdromes during the fall and winter of 1950-51 know the full story of how badly the British Meteor jets were outclassed when they attempted battle with the MiG-15s. Nor were the new aerial weapons planned for 1955 ready at their appointed hour.

To back up the Sabres' performance in MiG alley, the massive retaliatory capability of the B-36 and B-47 atomic bomber fleet was the sole resource available to the United Nations coalition to prevent the spread of the Korean war into a larger conflict. Since the Korean war, there has been a fashion among critics of nuclear airpower to cite all of the brushfire wars that have broken out despite the exclusive possession by the U.S. of this capability. This seems to us to be viewing the situation through the wrong end of the telescope. The really important fact is that from the crisis of the Berlin blockade in 1948 forward no major war has developed. Every brushfire thus far has burned out within its geographic boundaries without spreading because this nuclear retaliatory force existed.

The U.S. monopoly on massive nuclear retaliatory capability began to dissolve in 1955 when the Soviet Union demonstrated that it had nuclear weapons and both medium and long range jet bombers with which to deliver them. More recently the Soviets have boasted of an intermediate range ballistic missile capability to supplement this jet bomber force. And there is reason to believe the Russian claims in this field have some solid basis.

At the time of the Suez crisis, the Soviet threat of missile retaliation played a significant role in checking the Anglo-French invasion of Egypt. Apparently encouraged by this reaction, Soviet Premier Bulganin is now playing this same card against the smaller NATO countries to bluff and scare them out of continuing in the solid phalanx of Western power.

Norway, Denmark and the Netherlands have been recipients of Bulganin's notes threatening massive retaliation if they take an active role in any military action against the Soviet bloc. Indications are that the NATO countries are not ready to change policy in the face of this Soviet bluster.

If this is true, the Soviets are in the position of a poker player who finds his hand not strong enough to stay in the game and must either lose his ante or pluck some new and hopefully better cards from the deck. It will be interesting to see whether the Soviet subsides in these missile threats or stages some spectacular public demonstration of its capability to back its hand. The latter was U.S. policy in staging its round-the-world nonstop flight of B-52 bombers demonstrating for all to see that our retaliatory power was no myth.

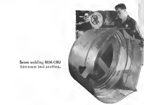
The combination of British dependence on USAF missiles and the development cycle looming for those missiles to become operational poses a critical problem for the next five years.

Will the B-52 fleet of the Strategic Air Command retain its current high degree of retaliatory potency for the full period before long range missiles can take over this function?

Or will we face a dangerous gap between the time the B-52 fleet is dangerously far down the obsolescence curve and the missiles become effective weapons?

Present outlook is that neither Britain nor the U.S. are preparing to develop a generation of interim weapons to fill this dangerous gap.

—Robert Hotz



WHO'S WHERE

In the Front Office

Gen Thomas B Wilson, board chairman, Resort Airlines of Delaware Gen. Wilson succeeds **Clinton Davidson, Sr**, who continues as president.

Ben Regan, board chairman Frontier Airlines, Inc Mr Regan succeeds **Louis E Leverone**, deceased Also **Preston Walker** and **Joseph E Wagner**, directors

Richard W. Hodgson, executive vice president and director of research The Ampex Corp Los Angeles Calif **Walter Y Fish** succeeds Mr Hodgson as vice president engineering

Lee S. Johnson, vice president United Aircraft Corp., Bridgeport, Conn Mr Johnson is general manager of the Sikorsky Aircraft division

Nathaniel Brewer, vice president-technology and chairman of the company's executive committee Fischer & Porter Co., Hatboro, Pa Also **Alexander Greenfield** director-research development, engineering

Donald C. Webster, vice president Librascope Inc Glendale Calif

Dr Royal Weller, vice president-engineering Stromberg-Carlson, division of General Dynamics Corp Rochester, N Y

Arthur S Nippes, vice president and general manager Henry Disston Division, H K Porter Company, Inc, Philadelphia

John E Canaday, vice president public relations, Lockheed Aircraft Corp, Burbank, Calif

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Horace Bolding, vice president purchasing and stores Braniff International Airways

H G Sturgeon, deputy managing director de Havilland Propellers Limited, Hatfield, Hertfordshire England

Edgar Allen (Pete) Goff Jr., assistant to the president, Link Aviation, Inc., Binghamton N Y.

John W. Dregge, chief routes division, and **Jacob W Rosenthal**, chief-carrier relations and services division Civil Aeronautics Board, Washington, D C Foregoing appointments were announced in connection with the reorganization of the routes and carrier relations division of CAB's Bureau of Air Operations

Honors and Elections

The Air Research and Development Command Baltimore Md was named recipient of the Daedalian Trophy for 1956 by Gen Nathan F Twining USAF Chief of Staff Gen Thomas D White USAF Vice Chief of staff presented the silver cup to Lt Gen Thomas S Power, Commander of ARDC The trophy is presented annually to the USAF major command having the most effective aircraft accident prevention program.

Harry F Guggenheim, president of The Daniel & Florence Guggenheim Foundation has received the Laura Taber Barbour Award The award which is administered by Flight Safety Foundation, Inc, was created to recognize notable achievement in the promotion of safety in air flight.

(Continued on p 181)

INDUSTRY OBSERVER

▶ Russia's Intermediate Range Ballistic Missile (AW March 12 1956, p 98) has a burning time of approximately 125 sec, a sea level thrust of approximately 275,000 lb. Weight of the missile at burnout is about 15,000 lb, gross weight at takeoff is approximately 150,000 lb Missile is now fitted with rounded nose cone

▶ **Polaris inertial guidance package will undergo acceleration and vibration tests this summer at the Supersonic Naval Ordnance Research Track, China Lake, Calif Massachusetts Institute of Technology has the overall responsibility for the package which will be built by General Electric G E. also will build the shipboard fire control system for Polaris**

▶ Packard-Bell received a contract for work on a chain of guidance stations throughout Africa in connection with the testing program for USAF's Thor, Douglas-developed Intermediate Range Ballistic Missile

▶ **Boeing is proposing a new wing for the B 52 designed to give the strategic bomber a significant increase in range.**

▶ Wright Air Development Center Materials Laboratory has a high priority Strategic Air Command requirement for a parachute that can withstand JP-4 jet fuel fires for periods of 4 10 sec

▶ **Packard-Bell Aircraft received a substantial order for work on the guidance system for USAF's Thor Intermediate Range Ballistic Missile.**

▶ Industry is showing widespread interest in Army's aerial jeep competition Army is now considering 28 designs from 21 contractors, some of them major Air Force and Navy weapon system builders Typical entry measures 10 by 20 ft., carries a 1,000 lb payload and has a limited range of about 25 mi at a speed of 30 kt

▶ **Bell Aircraft's XV-3 convertiplane is scheduled to begin tests within the near future in National Advisory Committee for Aeronautics' wind tunnel at Langley Field, Va**

▶ Northrop received a new USAF order for an additional 50 Snark subsonic, turbojet-powered missile with intercontinental range

▶ Work is well advanced **at Marquardt Aircraft Co on nuclear ramjet engine, although powerplant has not yet reached the hardware stage**

▶ Snecma is developing an aerodynamic afterburner system which eventually will replace the present mechanical flame catching device The new technique consists of the injection of air (bled either from the compressor or from the combustion chamber) into the main jet flow so as to form fluid screens These screens in turn set up micro-vortexes and thus facilitate the propagation of the flame

▶ Morane-Saulnier has registered its first civilian order for its four-place executive jet aircraft, the 760 Paris. Order was placed by **the Shah of Iran.**

▶ Army conducted tests to determine flight characteristics of a helicopter with wings Vehicle used in tests was old Piasecki HRP-1

▶ **Convair will incorporate a skip flow generator into its upward ejection seat for high performance aircraft**

▶ Monthly production rate for Dassault Super Mystere B 2 fighter bomber is scheduled to reach 15 before the year's end. First production model was flown Feb 27, and first French air force squadron using the B 2 is scheduled to be formed sometime this fall

▶ **Army's air transportable Package Power Reactor prototype stationary nuclear power plant achieved a chain nuclear reaction for the first time earlier this month Output of reactor, now undergoing tests at Ft Belvoir, Va, will be 1,855 kilowatts**

Washington Roundup

Protest For R&D

Watch for increasing protests against the cool attitude of Pentagon civilian administrators toward research and development Rear Admiral John E. Clark, Director of Guided Missiles for the Chief of Naval Operations pointed the way last week in a speech to the Institute of the Aeronautical Sciences at Cleveland

In defense of multiple development projects, Adm Clark said that fast progress has been made but the reliance on one approach to the missile problem could have resulted in no missile at all and a huge waste of money He also cited the case of an automobile company that paid the way for 12 developments before settling on one automatic transmission for production The Navy, in contrast, has selected two air-to-air missiles out of six development projects Adm Clark quoted a General Motors Corp executive and scientist as saying that "guided missile problems must be approached from the research rather than the design point of view"

Vanguard Cost

Total cost of the Vanguard satellite program may never be known Funds are provided separately from regular Defense Department appropriations by the Bureau of the Budget Other branches of the armed forces in addition to the Navy, are providing facilities and manpower Navy Secretary Thomas S Gates, Jr, says the Budget Bureau already has been asked for additional funds to finance the project Meanwhile, the initial rocket engine delivered by General Electric Co, was turned down by the Glenn L. Martin Co, prime contractor in the Vanguard project, for failure to meet specifications Secretary Gates says corrections will be easy and will not delay the firing, which he expects to take place late next year

Overselling Penalty

Civil Aeronautics Board will soon take formal action against scheduled airlines that have been deliberately overselling flights as a hedge against no-shows James Anton, chief of CAB's compliance section, told the House Commerce Committee last week that complaints had been drawn up and will be filed shortly against "flagrant" violators who still persist in overbooking flights despite earlier warnings by the CAB.

In another move, the Air Traffic Conference adopted a $3 no-show penalty ruling to go into effect on Sept 15 if approved by the CAB. The airlines, however, modified the minimum time limit on ticket pickups to 30 min before flight time, although reservationists will encourage earlier ticket pickup. A reconfirmation ruling requiring passengers to confirm return and continuing space six hours before departure time will be re-established July 15

Permanent Certificates

Outlook is good for the enactment of legislation providing permanent certificates for domestic all-cargo carriers. Senate Commerce Committee already has approved the measure Carriers that would be affected are Slick Airways, The Flying Tiger Line, Riddle Airlines, and AAXICO

Meanwhile, Chairman Warren Magnuson (D., Wash.), of the Senate Commerce Committee has introduced legislation providing permanent certificates for carriers operating between the U S and Alaska–Northwest Airlines Pacific Northern Airlines and Alaska Airlines

Information Clash

Members of the House Government Information Subcommittee are clashing with top Defense Department information officials as to whether recent directives issued by Defense Secretary Charles Wilson will increase or cut off the flow of information to the public

The directives are a partial implementation of the recommendations of a special advisory committee headed by Charles Coolidge (AW Nov 19, p 28) A new series of directives to complete implementation is expected

Subcommittee Chairman Rep John Moss (D., Calif) charged that the recommendations "erect new and higher barriers to the flow of information"

Robert Dechert the Defense Department's new general counsel, denied this and Murray Snyder, new Assistant Secretary of Defense for Public Affairs, promised that "several months from now we will be able to produce a record that will be consistent with the objectives of the subcommittee and with the objectives of the news media that have been so zealous in fighting for and protecting the peoples' right to information"

There was unanimous agreement on one point That the flow of information hinges largely on the "attitude" of the responsible information personnel

Moss commended Dechert and Snyder for being "helpful and cooperative"–a sharp contrast to the continual charges of obstructiveness directed by him to former Assistant Secretary of Defense for Public Affairs, Robert T Ross

Flight Recorders Too High?

Airline industry is objecting to the proposed installation of flight recorders on all aircraft because of the cost involved During oral arguments last week before the Civil Aeronautics Board, which is considering the proposal, it was estimated that the initial costs to airlines would total $6 million The device would record altitude, compass headings, speed and time and is built to resist terrific impact and fire The information recorded would be valuable in the event of a crash Hearings are being held to determine whether the CAB should order airlines to install the recorders

Northeast Stock Case

Sen Henry Jackson (D, Wash) will preside at hearings–scheduled to start May 1–on an alleged "leak" of information from the Civil Aeronautics Board last fall on the award of a New York-Miami route to Northeast Airlines The staff of the Senate Permanent Investigating Subcommittee completed an investigation late last year, and the case has been on the agenda for hearing since the session convened in January It was postponed because of the occupation of Sen John McClellan (D, Ark), committee chairman, with labor racketeering hearings before another committee It now has been agreed that Sen. Jackson, second ranking member, will take over the case Hearings are expected to last no more than two or three days

—Washington staff

CAA Proposes Expanded Airways Plan

Six-year plan drafted to break traffic bottleneck; Vortac coverage would be provided entire U. S.

By L. L. Doty

Washington—Details of an expanded airways plan that calls for complete Vortac coverage over the entire U S up to 75,000 ft by 1962, were disclosed last week by the Civil Aeronautics Administration

The vast project, which embraces CAA's original telescoped three-year plan and also proposes eventual automatic control of traffic, is a major step toward a breakdown of traffic bottlenecks through the use of electronic computers, Vortac and a radar system that includes long-range, airport surveillance, precision approach, secondary and surface detection equipment

Full implementation of the program to be known as the six-year federal airway plan, is scheduled for 1962 By then CAA predicts it will be handling 25 million civil aircraft operations annually as compared with 15 million last year Cost of the system—$810 million for facilities $425 million annually to operate and maintain.

What Plan Provides

Highlights of the projected system which underscores increased traffic capacity and extended coverage as basic objectives

- **Elimination** of the incompatible four course L/MF range facilities and the implementation of rho/theta (distance-bearing) coverage on existing and planned airways as low as 700 ft above the ground Additional rho/theta facilities and terminal aids will be established on airways and airports expected to generate increased volumes of traffic in the future To handle high altitude turbine aircraft, interference free rho/theta coverage from 18,000 ft to 75,000 ft will be established over the entire U S
- **Additional rho/theta facilities** will be placed into service on high-density airways and airports to permit lateral separation of aircraft on multiple express airlanes and on in-and-out airport routes
- **Victor airways (VHF)** will be revised to reduce traffic conflicts and permit wider use of express airways
- **Stratification** of air space to allow safe segregation of long-haul and short-haul traffic and to permit climb and descent tracks to and from high altitude strata
- **Installation of precision approach aids** with ILS and intensity approach lights as a means of reducing visibility and ceiling minimums
- **More flexibility** in the use of radio fixes by employing distance measuring equipment and tracks for position reporting at critical points

Warning From Pyle

Administrator James T Pyle warned that success of the plan depends largely upon full-scale research and development, particularly in the later stages of implementation He said a "development plan" will be introduced this year to augment airways evaluation projects conducted by the CAA Technical Development Center.

However Pyle told the House Appropriations Subcommittee that the $2.8 million requested in the Fiscal 1958 budget for Technical Development Center operations represented about one-third of the research effort contemplated Harber, Lloyd Pepper a member of the Aviation Facilities Planning Group headed by Edward Curtis predicted that adequate evaluation facilities would cost up to $50 million a year

The plan has been endorsed by presidential aide Curtis and was approved by the Air Coordinating Committee after a three-month review of the proposed system

The six-year plan closely parallels the basic Curtis plan as it is now known However differences on the subject of positive control of all air traffic may arise Curtis has indicated that the "see and be seen" principle must be retained in some areas but Pyle has asserted that all traffic will be under some sort of positive control within five years

Vortac Largest Item

Largest item in the program is Vortac, which was adopted last September in a compromise agreement between civil and military aviation to combine the rho features of Tacan with the theta features of VOR (AW Sept 3, p 41)

The Vortac program has been given top priority by the CAA, and funds for its installation amount to $255 million, or almost one third of the total cost of all facilities required for the six year plan Annual maintenance and operation cost of Vortac is estimated at $72 million beginning in 1962

Commerce Secretary Sinclair Weeks said the Maritime Administration's ship construction program had been reduced by $25 million to absorb the cost of the initial Vortac program First installation of a Vortac ground unit is at Phillipsburg Pa

Basic coverage of Vortac will be upwards of 700 ft, and signals will provide all airspace coverage above altitudes of 18,000 ft mean sea level CAA has determined that Vortac must be installed in a crash program at 300 locations before 1960 in order to meet civil and military jet requirements Pyle has admitted that the unexpected surge of orders for jet transports "caught us by surprise"

A total of 1,230 Vortac installations are scheduled for completion by 1965 Commissioned distance measuring equipment in the present system will be retained until 1960 except where frequency conflict demands a phasing out of the units No further DME will be installed Existing VOR units will be suitably modified to integrate Tacan capability

Expanded Radar Coverage

An important key to the overall program is the expansion of radar coverage Use of long-range radar airport surveillance radar (ASR) and the air traffic control radar beacon system (secondary radar) will allow better utilization of airspace and a reduction of controller workload

Tied-in with airways radar is the further development of better displays that will stand up under daylight conditions Projection techniques are now under evaluation study at CAA's Technical Development Center (AW Oct 29 p 40).

Long range radar is expected to relieve traffic bottlenecks by separation of aircraft on a spot basis in place of the restrictive time separation now required

First phase of the long-range radar program calls for the implementation of extended terminal area coverage during the Fiscal Years 1957 and 1958 At present long range radar is in operation at the Washington air route traffic control center and FPS 8 equipment has been supplied by the Navy and Air Force at New York and Norfolk pending CAA procurement of long range units

The immediate plan provides for complete overlapping radar coverage between Boston and Norfolk for trial use of the system

En route coverage for congested airways and high altitude coverage—above 15,000 ft—is scheduled for installation in 1958 and 1959 Although the plan indicates a need for 73 long radars CAA feels this will be insufficient for full coverage An interchange of radar systems between the CAA and the Air Defense Command is anticipated as one means of absorbing a part of this deficiency and a joint CAA/ADC planning group has been established to study radar requirements

CAA warns that additional funds will be required for the long range radar program to cover future costs of new electronic features, introduction of improved equipment and relocation of facilities as found necessary by operational experience Total cost of long range radars is expected to reach $86 6 million during the six year program Maintenance and operating costs will amount to $71 million annually

Airport surveillance radar and military radar approach control facilities such as RAPCON will continue to be important parts of Common System ASR will be implemented at all major transportation hubs or at any airport having CAA airport traffic control service and 2,000 or more annual instrument approaches

A total of 70 ASRs will be installed during the next six years in addition to the 45 currently in operation

Precision approach radar will be established in 20 locations during the next six years Twenty three are now in operation Criteria of 3,000 or more instrument approaches annually as a standard for PAR installation is now being met by several airports but procurement has been temporarily shelved in favor of other equipment considered of greater importance

Surface Detection

Airport surface detection equipment (ASDE) for use in ground control of traffic has been under CAA evaluation study since 1951 Extensive tests were undertaken at Indianapolis and Minneapolis and final operational tests were made at Idlewild Airport, New York

CAA expects to place orders for ASDE in Fiscal 1958 provided additional evaluation supports earlier findings If demonstrated to be satisfactory ASDE will be installed at 74 locations

Total procurement and installation cost of ASR, PAR and ASDE will amount to $55.5 million. Operation and maintenance costs will be $59 5 million a year

Air traffic control radar beacon system or secondary radar will cost $24 million The radar beacon is still in the development stage but CAA hopes to install 188 beacons for civil surveillance radar systems by 1962 and an additional 42 for all operating and planned civil PAR systems

Tests on partially completed components of the beacon system have been conducted since 1954 and a nine station in-service testing of the system will begin as soon as all components are available The beacon program is sponsored by the Air Navigation Development Board

CAA is actively pursuing a development program involving the automatic collection processing transfer and display of control data in a move to eliminate manual performance of control functions by controllers Electronic data processing (datamation) techniques are now under development at the Technical Development Center (AW Nov. 12, p 83)

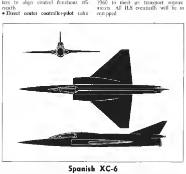
First phase of the system calls for automation teletype switching centers to route messages to proper centers where they will be fed into digital computers and magnetic storage drums

Biggest barrier to the use of electronic data processing techniques is that centers receive aircraft flight plan information in void form—a form computers cannot accept However, Pyle is optimistic over the potential of the new techniques and says "automation holds real promise for the future" but admits "it is still pretty far in the future"

Other Projects Planned

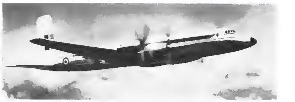
Other projects planned by CAA for the six-year plan

- **Air route traffic control centers.** A small number of new centers may be established to ease workload and reduce costs of remoting radar and data communications A total of $103 million will be required for relocation of centers improvements to accommodate radar equipment and expanded quarters to align control functions efficiently
- **Direct center controller-pilot** radio telephone service Plans call for radical improvement of air-to ground communications CAA wants to eliminate air line intermediaries in communications and provide direct communication between controller and pilot
- **Airport Traffic Control Service**—$29 8 million is needed for improvement, relocation and modification of control towers The plan provides for the addition of 77 towers during the next six years
- **Phasing out of various navaids** is expected during the next six years These include 75 mc fan markers, 185 L/MF non-directional radio beacons, 832 airways light beacons The number of airway light beacons reached a peak of 2,020 in 1945
- **Direction finding equipment** VHF/UHF DF will be installed at all long-range radar and ASR locations Delivery of the first 60 sets is now in progress but no installations are programmed for Fiscal 1958 because of more pressing requirements
- **Instrument Landing System**—$58 million is allocated for ILS installation during the next six years This will include the addition of 119 ILSs to the 158 now in operation Future budget requests will provide for the addition of a second ILS at airports bogged down by heavy approach traffic ACC has recommended phasing out of DME equipment and the addition of Tacan distance equipment to 70 ILS's by 1960 to meet jet transport requirements All ILS eventually will be so equipped



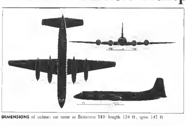
Spanish XC-6

Spanish XC-6 supersonic, delta-wing light fighter designed by Germany's Willi E. Messerschmitt for Hispano Aviacion S A is powered by a Bristol Orpheus turbojet engine Proposed armament for the area ruled fighter includes two 30 mm. Hispano cannon



TRANSPORT VERSION of Canadair CL-28, ordered by RCAF will be offered in civil version Design is based on Bristol Britannia.

Canadair Re-Enters Transport Market



DIMENSIONS of airliner are same as Britannia 310 length 124 ft, span 142 ft

Montreal—Canadair, Ltd , which will build under Royal Canadian Air Force contract a Bristol Orion turboprop-powered version of its CL-28 maritime reconnaissance plane, will offer a civil transport version to international air lines priced at approximately $3½ million

Under an agreement with Bristol Aeroplane Co Canadair acquired world sales rights for a commercial cargo version, limited sales rights for the civil transport version in the U S, Canada, the Scandinavian countries and Switzerland and conditional rights in various countries for the military transport airplane It has exclusive world sales rights for the CL 28

Canadair Versions

The RCAF order and subsequent Canadair civil offer brings into existence a Canadair design family sired by the Bristol Britannia, which is powered by Bristol Proteus turboprop engines

Canadair's versions of the airplane

- CL-28, designated the CP 106 Argus by RCAF Powered by Wright 3350 Turbo-Compound piston engines for long range at low altitudes this airplane retained wings and tail of Britannia but has extensive fuselage changes for its military anti submarine mission.
- CL-44 transport version for RCAF Using the 5,000 eshp Orion it will carry 120 passengers or a maximum payload of 45 000 lb of cargo Cruising speed will be about 400 mph range 4,000 mi
- Civil version, designated the CL-44 also pending possible name choice by a customer

Dimensions of the RCAF version designated CC 106 by that service, are the same as the Britannia 310 long range transport 124 ft long 10 ft longer than the CL-28 fuselage 142 ft span and 36 ft 6 in height same as the CL-28

First RCAF deliveries are scheduled for late 1959 Because many of the same jigs tools and fixtures can be used from the CL-28 now in production, cost saving will be substantial

RCAF contract was described only as a multi million dollar order However Canadian government officials have referred in Parliament to an order of eight Total production undoubtedly be larger for the RCAF to lighten the effect on Canadian budgets usually orders aircraft in small batches over a period of several years

RCAF Replacement

Transport will replace RCAF's North Stars Seventy of these Rolls-Royce Merlin-powered transports based on the Douglas C 54 and DC 6 designs were built Trans Canada Air Lines operates North Stars but is committed to a Vickers Viscount and Vanguard re equipment program Canadian Pacific Airlines with five Britannias on order at a cost of $3 million each is a potential CL-44 customer

Canadair has sought to re-enter the commercial transport field since the end of the North Star program seven years ago and its abortive CL-21 proposal for a DC 3 replacement

The Orion engine, flown in a Britannia test bed since last August, is twin spool supercharged engine which is in effect an 8,000 eshp engine but governed to deliver a constant 5 000 eshp from sea level to 15 000 ft This Bristol says will permit the aircraft it powers to take off at maximum gross weight from any airport in the world, irrespective of elevation

Orion will develop 3,800 eshp at 30 000 ft which, Bristol says, is 50% as much power again as a conventional turboprop at the same altitude At cruising altitude Bristol says, the Orion fuel consumption is superior to turbo Compound piston engines

In territories where Canadair has rights Canadair is prepared to supplement the number of Britannias that will be built Commercial sales effort for the transports will be coordinated with Bristol

Canadair is a subsidiary of General Dynamics Corp, whose Convair Division produces the Convair 440 twin piston-engine transport and is starting production of the 880 turbojet transport

Sales program also will be at least informally coordinated with Convair As an example, Canadair now is close to having sold the RCAF Convair 440 transports

Inertial Navigation Flew B-29 Across U.S.

Inertial navigation system developed by Massachusetts Institute of Technology Instrumentation Laboratory has automatically flown an Air Force B 29 from Boston to Los Angeles bringing it within "less than 10 miles" of its intended destination

The flight took place on February 9, 1953, using experimental equipment which weighed more than a ton but equipment size and weight have since been slashed

Dr C S Draper, head of MIT's Instrumentation Laboratory who disclosed the flight last week predicts that present inertial guidance system accuracies can be improved by a factor of 10 in the next decade MIT currently is developing an inertial navigation system for use with the Navy's Polaris, Intermediate Range Ballistic Missile

USAF Changes Plan, Gives Firm Schedule to Nuclear Plane Project

Washington—Air Force is putting its nuclear aircraft project back on "permanent" status with the first flight scheduled for sometime in the mid 1960s

USAF's decision to "restore a definite timetable" for the project was reported by Rep Melvin Price (D, Ill), chairman of the Joint Congressional Atomic Energy Subcommittee on Research and Development, after a series of executive sessions with USAF Secretary Donald A Quarles

Price who earlier protested the Air Force's original decision to take the nuclear aircraft project off a definite schedule and reduce its budget (AW Mar 11, p 30), said that he is "reassured" but "not satisfied" with USAF's new approach

Price told Aviation Week that "there are no technological barriers serious enough to warrant a slow-down" of the project "On the contrary, they are challenges for additional effort" he declared.

Quarles told Price's subcommittee that USAF had reviewed the project because with development the plane became heavier and slower and that USAF is now seeking to design a more compact engine with lighter shielding postponing the actual design of the aircraft

The ANP project is now at a level of approximately $200 million annually This is about half the amount requested for fiscal 1958 by USAF last fall

Price reported that the Air Force has also given assurances that the organization for handling the various segments of the ANP program would be streamlined to give "tighter over-all supervision" He said this will "only partially" meet his proposal that a single administrator "with sufficient authority to get the job done" be appointed for the ANP program

"Contractors have met their schedule," Price said "The main difficulty is in the Pentagon where administrative confusion and indecision over research and development objectives have marked the conduct of the program" He said that "at least putting the program back on a timetable will eliminate the apprehensions of contractors that at any time the project will be tossed out"

Present contractors are Lockheed and Convair for airframes, and General Electric and Pratt & Whitney for engines

Price also criticized the Navy for "sitting back and not being sufficiently interested" in the atomic plane program Navy should be "actively participating" in it, he declared, with a view to seaplane development

B-47 Test Bed for Iroquois Takes Off

Modified B 47 test bed for Orenda Engines PS-13 Iroquois turbojet takes off in first flight at Montreal The aircraft modified by Canadair, Ltd was flown to Malton Ont where Orenda will install final instrumentation and engine prior to beginning flight tests in a few weeks. B 47 was chosen as test bed for the Iroquois because it was the fastest aircraft available capable of carrying the new engine Primary engineering problem was attaching the Iroquois so that buffet speed of the B-47 was not reduced The required subsonic tests had to be conducted at the B 47's maximum speed and altitude Problem was solved after an extensive wind tunnel program at Seattle, Wichita Ottawa,

Trident II Backed as Standard Fighter

Four European companies agree to pool efforts to build French design, press for common use.

By Robert Farrell

Paris—Four important airframe builders in western Europe have decided to pool their efforts in promoting the French-designed Trident II as the standard interceptor for western European defenses

Sud Aviation, French builder of the Trident, reportedly has an agreement to this effect with the Belgian airframe company, SABAC, and the Dutch firm of Fokker In addition to these three firms, a West German airframe company is a party to the agreement

The agreement between the four firms states that the Trident is the interceptor best suited for the special defense needs of western Europe The companies state further that they are willing to build the Trident in common and that they intend to press their individual governments to support the project

The four way accord is highly significant for the western European airframe industry Cooperation between European airframe companies has long been advocated as the only solution to continental aircraft production problems (AW Oct 15, p 21) The agreement is also unusual in that for the first time European companies are telling their respective governments which aircraft they think should be built. The normal procedure in western Europe is for governments to take the lead, with the companies rarely ever expressing their opinions publicly

Actually, the agreement was signed several months ago in Paris following a series of unpublicized tests made on the Trident by the various companies Since then the French Air Ministry has held up any announcement on the accord Last week in Paris, Georges Hereil, Sud Aviation president, said he could neither confirm nor deny the deal The agreement, however, has been substantiated by AVIATION WEEK

Durandal Shelved

By backing the Trident, built originally by Ouest Aviation—the French airframe company recently merged into Sud Aviation—the latter company apparently has decided to shelve its competing interceptor, the delta wing Durandal

The Trident II is a lightweight interceptor designed eventually to operate at Mach 2 speeds and above Powered by SEPR liquid propellant rockets in the tail and two wingtip jet engines, the straight wing Trident has flown in the Mach 1 9 range Sud Aviation presently has an order for ten pre production Tridents from the French Air Force

Trident, first flown in July, 1955, was designed specifically to meet both the military and economic needs peculiar to western Europe Generally, the military needs call for a Mach 2 interceptor operational at a minimum altitude of 50,000 ft Despite the high-speed requirement, the interceptor must have a low landing speed and be capable of getting in and out of short fields Range is not stressed With the distance between the enemy and the interceptor's base considered nil, one hour's flying time is judged sufficient for carrying out the interceptor's mission

Economic requirements in western Europe are usually dictated by lack of funds and lack of "elbow room" Long airstrips are expensive to build, and in western Europe it is often difficult to fit them into the already crowded landscape without stirring up local interests More important than military budgets in western Europe require that the ideal interceptor be inexpensive, easy to build and cheap to operate

Meets Requirements

The companies signing the agreement claim the Trident II fully meets these military and economic requirements

Trident can land and take off within 500 yards Fitted with low pressure tires, it can use grass or other unprepared landing areas Despite its Mach 2 speed, the Trident lands at 90-100 kt Reportedly the aircraft is no more difficult to fly than a jet trainer and its instrumentation is said to be less complicated than most World War II fighters For example, complete power control for the two-chamber tail rocket engine operates off one lever

Production layout for the Trident has been simplified to the point where manufacturing costs are said to represent only 20% of the total cost It has been estimated that at least four Tridents can be built for the price of one USAF F-104 Extensive use of honeycomb material and metal to metal bonding has produced a light airframe of extreme rigidity Gross weight of Trident II is 11,355 lb, allowing 5,788 lb for equipped empty weight, 242 lb for pilot, 330 lb for air to air missile carried externally under fuselage, and 4,995 lb for fuel and oxidizer

Trident's low aspect ratio wing is simple box arrangement using honeycomb material and metal-to-metal bonding Profile and chord are constant over entire span Complete wing consists of only four or five different elements It appears that such elements as the four full span, high lift flaps as well as the leading edge sections are interchangeable Same is true for the three trapezoidal tail surfaces Overall wing span is 22 ft, 6 in while wing area is 155 sq ft Height is 10 ft 3 in

Classic Construction

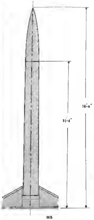
Trident II fuselage is of classic construction composed of perfectly circular frames and longitudinal stringers Length is 42 ft, 6 in Nose section includes pressurized cabin with jettisonable canopy and a light ejector seat All hydraulic, electrical and radio equipment is housed in a single unit behind the pilot Mid-section of fuselage contains the fuel and oxidizer tanks which can be rapidly jettisoned Upper aft section of fuselage houses two airbrakes while rocket engine is contained in lower part

It is understood the area rule concept was considered for the Trident II but was finally rejected by Designer Lucien Servanty. Many French designers think the area rule concept loses its validity at speeds beyond Mach 1 4 in that the advantages gained are offset by design complications

Trident tricycle landing gear retracts into fore section of fuselage Gear is lowered under combined effect of its own weight, induced drag and a pneumatic booster

Control of the aircraft is carried out entirely by tail unit of three one-piece surfaces which pivot freely around their axes and which are actuated by irreversible servos Vertical surface acts as rudder while other two surfaces insure bank and pitch control Whole unit is operated by conventional cockpit controls With wing ailerons thus eliminated, it was possible for designer Servanty to install the high lift flaps along the entire wing span to facilitate low landing speeds

Present version of Trident II is powered by a pair of Dassault-built Armstrong Siddeley Viper turbojets of 1,650 lb thrust each, plus two-chamber SEPR liquid propellant rocket engine installed in tail and delivering maximum ground thrust of 6,615 lb Rocket engine is prime mover, with each chamber being operated separately or in unison It is probable that most of the ten pre production Trident IIs now being built by Sud Aviation will be equipped with a pair of wingtip Turbomeca Gabizo jets of 2,400 lb thrust plus afterburners



Navy Sounding Rockets

First picture of Arcon upper air research rocket (left), shows vehicle being developed by Atlantic Research Corp for Naval Research Laboratory on a Bureau of Ordnance contract (AW Oct. 1, p. 29) Atlantic also is developing larger research rocket, Iris (diagram), for NRL Arcon, with 6 in. diam and overall length of 11 ft. 2 in, will carry a 40 lb payload to 70 mi It is single stage, solid propellant, weighs 250 lb Nose cone in this picture is not one which would be used in actual firings Solid propellant Iris will carry 100 lb payload to 200 mi It is intended as a replacement for liquid propellant Aerobee-Hi, which is more difficult to handle on shipboard. Also shown is Hasp, (High Altitude Sounding Projectile) (right) which is based on Army Rocket Loki. Hasp will be fired from shipboard 5 in. guns, will seek temperature and humidity data at altitudes of more than 20 mi

Briton Sees Waste in French Parca Missile

London—Member reported to Parliament this week on a French guided missile called Parca which he had seen at the French Vernon research establishment He said it bore a close resemblance to an early British ground-to-air weapon.

Conservative James Hutchison said France had spent $28 million on it

"What a waste in scientists time and money," Hutchison asserted "It cost 10 million pounds ($28 million) to develop a weapon which seemed to me almost identical to a weapon produced by us two or three years before—and I dare say that we were one or two years behind the United States . . ."

X-17 Travels 700 Mi.

Lockheed Aircraft's X 17 hypersonic test missile recently reached an altitude of over 600 mi and travelled more than 700 mi in an unplanned demonstration of its capabilities

The distance and altitude marks were set when the three-stage missile failed to tip over, and the rocket motors normally used to drive it downward as part of USAF's re-entry tests in the Intercontinental Ballistic Missile program fired it to new heights Normal range of the vehicle is about 200 mi

Air Research and Development Command's Western Development Command, which has fired approximately 20 of the test missiles to date from USAF's Missile Test Center, Patrick AFB, Fla has substantially completed work with the X 17

Of the total missiles fired, 17 functioned perfectly, successfully duplicating the re-entry conditions of an ICBM in that the combination of the speed, altitude and dense air encountered in the X 17 tests were roughly equivalent to the conditions an ICBM will encounter at its higher altitude, higher speed and thinner air

The X 17 program may now be taken over by the Navy to help accelerate the development of its Polaris Intermediate Range Ballistic Missile

PEROXIDE provides fuel for Pinwheel

PILOT uses feet for initial touchdown

Simple Rocket-Powered Copter Demonstrates Use for Infantryman

By Richard Sweeney

Van Nuys, Calif.—To meet a design goal of a short-range light, simple helicopter which any foot soldier can strap himself into quickly and operate efficiently, Rotor-Craft Corp. has built a monopropellant rocket powered helicopter dubbed "Pinwheel."

Capable of carrying a fully equipped infantryman plus additional ordnance, such as a flame thrower or 75 mm recoilless rifle, the Pinwheel has been under development since 1950 with Office of Naval Research and company funds. It was demonstrated publicly last week.

Design Details

Features include:

• **Ultra simple propulsion system** in which 90% hydrogen peroxide is fed into fully throttlable engines, one in each rotor blade. These are primarily metallic catalysts which cause peroxide decomposition. Resulting high velocity steam jet propels free rotating blades by exiting through a single nozzle in each blade tip trailing edge. Engines are buried in blade tips, produce only slight variation in blade profile.

• **Uncomplicated fuel system.** Dual tanks mounted on each side of pilot's saddle supply fuel to engines simultaneously through rotor head. Initially fuel is pumped to engines by pilot-operated hand wobble pump. As propellant reaches engines and blade rotation starts a fuel pump located in the rotor head and actuated by blade rotation takes over at about 200 blade rpm.

• **Starting procedure** that complies with original design concept. Observed starting procedure consisted of checking emergency fuel shutoff valve for open operating wobble pump until fuel reached engine where decomposition started and steam began blade rotation. Working throttle with left hand while his right operates wobble pump, pilot starts machine while in the seat and without any assistance. The helicopter has no ignition, no wiring in propulsion system. No ground support is required except refueling equipment, which under field conditions can consist simply of a drum of hydrogen peroxide and a hand cranked pump to bring fuel from drum into Pinwheel tanks.

• **Logical, simple control system.** Lever on lower left side of pilot's saddle is lifted to gain altitude, lowered to descend. Twist grip on the lever is the throttle. It is twisted outboard for higher rpm., inboard for slower. Tube comes down from the rotor head assembly over the pilot's head to a position in front of him. Mounted at the bottom of the column is a second control handle. Rotation left or right controls direction. Pushing it forward or pulling it back controls horizontal air speed.

Only two gages are used on the copter, a blade tachometer and airspeed indicator, both mounted in a small housing on the control tube just above the front control handle. Presently, airspeed pitot head is attached to this case, just a few inches ahead, but readings obtained in this rotor downwash disturbed area indicate a new pitot head location is desirable.

Green line operating limits for rotor speed are 640 to 740 rpm.

Pinwheel weighs about 150 lb. dry. Fuel capacity is 10 gal., giving machine a flight endurance of about 10 min. Indications are that redesign of jet exit nozzle can increase thrust as much as 50%. This can add to range, reduce fuel consumption, or get desired range from reduced fuel load, enabling soldier to carry more ordnance.

Rotor Diameter

Pinwheel metal rotors are 17 ft. in diameter, have a 5 in. chord. Tail rotor is single blade, belt driven. In addition, two horizontal stabilizing fins about 1 ft. in span and 5 in. in chord are mounted aft of the directional rotor, have inhedral of about 25 deg.

The machine rests on tripod leg system. Landing is affected first on pilot's feet, and then the helicopter is allowed to drop a few more inches onto the tripod. Ascent can be with pilot's feet on small footrest in front of him, or with feet on ground position.

Test pilot Richard Whitehead flew Pinwheel at speeds up to 75 mph. in the demonstration. Only real limit seen at present is wind blast on unprotected pilot. The machine is so constructed that addition of a small "outboard" type motor on aft section driving a pusher propeller, could add substantially to the machine's forward speed or add range by producing an autogiro-type flight.

Combination of Pinwheel's design parameters have resulted in a machine with excellent autorotation characteristics. In case of fuel exhaustion or engine malfunction, valuable blade kinetic energy is not dissipated in disconnecting rotors from a drive shaft, and no clutches are used in the system, which essentially is autorotating blades with tip power plants. Company says machine's autorotation rate of descent is 22 fps., approximately the same as that of a parachute. Weight of engines in blade tips plus machine's low disk loading join with other design features to produce, just before touchdown from an autorotation descent (which can be safely started in Pinwheel much lower than in conventional helicopter), a momentary hovering condition, giving pilot an even better chance for a very light touchdown.

Altitude Performance

Pinwheel's rocket engine has no altitude limitations. Only limits are pilot's oxygen needs and fuel. The helicopter has been test flown at pressure altitudes of 8,000 ft. and it has been flight tested from Denver's Stapleton Airport, more than 5,000 ft. above sea level.

In developing Pinwheel, which can be transported, stored or hangared in a wooden box 9 ft. 3½ in. long, 25½ in. wide and 32 in. high, Rotor Craft president Gilbert Magill was granted several patents in monopropellant, throttleable liquid rocket engines.

Currently the company has contract to flight test prototype machine, with hopes for production orders.

During the Pinwheel demonstration Magill also showed a wooden box 4 ft. 11 in. long, 16 in. wide and 21 in. deep which, he said, houses an even later one-man machine development which weighs less than 75 lb. dry.

Speaking of the company's plans Magill said he forsees production one-man helicopters of the extremely simple type his company has developed, priced in the range of $1,000.

Ryan X-13 Converts

USAF's jet-propelled VTOL research plane, the Ryan X-13 Vertijet, has gone through its first complete and continuous flight sequence at Edwards AFB, Calif.

Starting with a vertical takeoff, Ryan test pilot Peter F. Girard put the X-13 into horizontal flight, returned it to a hovering attitude and then landed.

There are two X-13's now at Edwards. The research models have been taking part in an 18 month flight test program. Purpose of the project is to test the feasibility of jet powered VTOL.

Tufted XH-40 Tests Rotor Wash

Tuft tests with Bell XH-40 check effect of rotor wash on air currents. Helicopter is towing an airspeed indicator bird, which flies out of wash, checks effect of wash on air speed indication. Note tuft patterns in cockpit and tail rotor areas.

Flying Atar Tested For French Officials

Bonn—First official test flight of the VTOL Flying Atar in the presence of French government representatives took place this week at Melun-Villaroche. This was announced by Snecma President Henri Desbrueres during the Aviation Congress held at Duesseldorf.

USAF, Industry Revise Spares Support Concept

By Claude Witze

Washington—Basic allocation of more funds for weapon systems and less for spares support will result from new provisioning policies now being worked out by the Air Force in co-operation with the aircraft industry.

According to Maj. Gen. Mark E. Bradley, Jr., Assistant Deputy Chief of Staff, Materiel, improvements already put into effect have reduced the cost of initial spares from 43.4% of the total aircraft program in Fiscal 1951 to 23.5% in Fiscal 1957. The General gives credit to recommendations and studies by the aircraft industry for making many economies possible. Key programs are:

- **Delayed Procurement Concept**, applied to high-cost low usage airframe items, officially became effective in January. Procurement and delivery of the spare item is deferred until a requirement exists or production has reached the point where a decision must be made to buy for stock.
- **Responsive Production Concept** to be introduced later this year will end the policy of ordering the full quantity of estimated initial spares. Only a portion of the initial spares will be ordered and material set aside for the balance.

USAF emphasizes that its Responsive Production Concept has no affiliation with the rules governing the mobilization program and will be a routine procedure. It is expected that the degree to which it is applied will depend upon the nature of the weapon system and the manufacturer's plant capabilities. It is assumed that some aircraft firms can control and promise delivery to USAF on a larger number of items than others.

North American Aviation, Inc., has made a study of the proposal to determine its effect on normal plant operations. According to Gen. Bradley, North American figures show that the program is feasible and could be applied to as many as 300 to 350 items in the case of a fighter aircraft. They would represent about 60% of the total cost of the initial spares requirement.

Responsive Production is expected to apply to the prime contractors and first-tier vendors but no lower on the subcontract structure. Emphasis will be placed upon high and middle cost items. There will be some decrease in USAF's control of low-cost items—those costing less than $10—and larger stocks of these units will be set aside.

As explained by Gen. Bradley, fabrication, assembly and shipment of units for which material has been allocated will not be ordered until it is possible to make an accurate prediction of the initial spares requirement.

Application of System

Application of the new system, it is pointed out by USAF spokesmen, should work well with missiles and the more complex aircraft weapon systems now being manufactured. Usually these weapons have to be provisioned before the Air Force has obtained any substantial operating experience. Delay in ordering spares will insure that when they are made they will be of the latest design and that they will not be left unused on the stock shelves.

The Delayed Procurement Concept already is in force on some weapon systems, including the Convair F-106, McDonnell F-101 and Lockheed F-104. Procurement of spare parts for initial support was curtailed beyond the first two production contracts.

Purpose of this approach is to obtain better consumption figures before starting full procurement.

To USAF procurement officials, the important result of the new system is that it will provide better support along with greater flexibility in the use of available funds. More effective management will result in fewer initial purchases, postponing the purchase of large quantities as long as possible.

Prior to Fiscal 1957, all spare parts were not funded out of the same USAF appropriation. Initial spares were paid for from the classification of aircraft and related procurement.

Follow-on spares were purchased with money from the operations and maintenance appropriation. Starting this year all have been paid for from the aircraft and related procurement appropriation, a step that has provided the administrators with more flexibility in use of the funds along with economy.

The procedure is described by USAF spokesmen as one of "continuous provisioning" instead of "initial" and "follow-on" provisioning.

USAF has three other procedures designed to improve handling of spares:

- **Return of stocks** to the production line when extra supplies can be utilized in the finished weapon system. Last year, $18 million in spares was returned to manufacturers under this system. The policy is applicable to long term contracts, such as the Lockheed T-33.
- **Analytical overhaul**, which applies mainly to engines and other recoverable components. After three to six months of use, the items are taken apart and spares orders are adjusted according to the amount of wear that has developed. This insures an even flow of necessary spares and alerts the contractor to points where design improvement is called for.
- **Stockage of spares in kit form** cuts down on the number of requisitions of replacement parts. This eliminates thousands of items from the stock lists, repackaging and shipping expenses. It speeds repairs and increases the service life of components after overhaul. It is used in the aircraft instrument and accessory areas.

No B-52 Increase

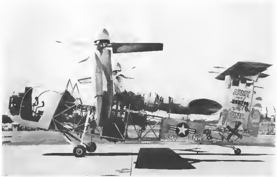
Washington—USAF announced late last week that it will hold production of the Boeing B-52 intercontinental jet bomber to the present rate of 15 a month instead of expanding it to the 20 a month goal announced last year. Output of the Boeing KC-135 tanker also will be held to 15 a month when that figure is reached in about a year.

It was emphasized that the Boeing plant capacity will be retained at a level where output of 20 bombers a month will be possible if the decision should be reversed. Total of 603 B-52s has not been altered but it will take an additional six months to reach that figure.

Congressional observers were not surprised at the decision. Some felt the slowdown was to be expected and that the significance of the schedule change was in the fact that USAF voluntarily announced the decision.

Infrared Proximity Warning

Proximity warning collision avoidance systems using infrared techniques will be proposed by four avionics manufacturers at Air Transport Assn. meeting in Washington, April 30, to May 2. Companies include: Aerojet-General, Farnsworth, Nevada Air Products and Raytheon. Spokesman says ATA has been deluged with inquiries and proposals for infrared proximity warning systems following Aviation Week's series on infrared which pointed out this challenging application (March 18, p. 94). Remainder of three-day meeting will include report by Bendix Radio on its new proximity warning/collision avoidance system program for the Air Force and an analysis by Boeing of the system requirements for its 707 jetliner. Organizations wishing to send representatives to the meeting should contact Frank C. White, ATA, Washington, D. C.



Vertol Unveils VTOL Model 76

Tilt wing Vertol 76 has reached test stage and is expected to be flying in near future. First pictures of the VTOL research aircraft, powered by Lycoming T-53 turbine engine, show how wing and two counter-revolving rotor propellers tilt through 90-degree arc. Hovering regime yaw and pitch are controlled by two ducted fans in tail section. Manufacturer says plane developed with Army funds in cooperation with ONR, is designed for STOL also. Wing can be rotated to any position depending on runway length and load.

Transatlantic Air Travel Rise Predicted

Survey estimates peak of 440,000 passengers for summer, an increase of 15%; schedule expanded.

New York—Transatlantic airlines will carry about 440,000 passengers on their scheduled flights this summer, an Aviation Week survey indicates.

After a relatively slow start early this year, bookings have picked up to where an increase of about 15% can be expected over the record June-through-September total last year of 380,265 passengers (AW Feb 18, p 38). Last summer's total itself represented an increase of 16% over the 1955 season.

With expanded fleets and a new fare structure over the North Atlantic, U.S. and foreign flag carriers are offering a peak total of 297 weekly flights in each direction this year. The total is 13% greater than last summer's, and many of the flights are scheduled in larger aircraft, raising the number of seats for sale.

Seats available this season should total about 671,250, up from 559,381 in both directions during the same period of 1956.

Mixed-class configuration dominates the transatlantic scheduling this summer. Mixed flights total 155 weekly at the peak, compared with 125 all tourist, 17 first-class, and 10 all de luxe flights.

The de luxe fare class is new this year. International Air Transport Association decided in 1955 to reduce standard first class fares, add a $50 one-way surcharge for the de luxe service. In standard first class configuration, seats are limited to a 42-in. maximum pitch. Bulk reclining "sleeper" seats now are features of the de luxe class.

Some reconfiguration has been made necessary by the change. For example, Pan American World Airways shuffled its Stratocruiser configurations, blocking the seats on its President schedules so they are no longer fully reclining. President is now a standard first-class airplane, while the President Special with two flights a week, will carry all de luxe class passengers.

Other changes in the 1957 fare picture include:

- **Elimination** of the off season fare, replaced by the year round excursion fare with 17 day limit.
- **Continuation** of family plan, but not in conjunction with excursion fare.
- **Extension** of new immigrant fare through June 30.

As far as the effect of the excursion fare on summer business is concerned, carriers' reports are mixed. Consensus appears to be that it hasn't been a big factor so far, may become one later in the season because many new tours are pegged to the 17 day plan.

KLM Royal Dutch Airlines says the excursion plan is "popular," finds it too early to be more specific. British Overseas Airways Corp. reports little business in excursion sales. Scandinavian Airlines System, proponent of a three-week time limit instead of two says the present plan "hasn't given us too much business."

Most carriers found their long-range bookings relatively lower during the first few weeks of 1957. But after a pause, bookings picked up again for later in the season and are now expected to continue that way.

Short-range bookings had remained heavy during period of hesitancy.

- **KLM's** bookings a month ago for April and May were higher than at the same 1956 date by 30% in the tourist category, 9% in first class. But bookings for June and July then were only 5% higher in tourist business, no higher in first class than as of March 1956.
- **Air France** found a "hesitancy" in January and February which has now passed.
- **BOAC's** bookings for this season were late-starting, are now 20% over last year.

Many travelers considering European vacations this year apparently waited to see if the political situation would worsen, decided it wouldn't, and went ahead with their plans.

- **Sabena Belgian World Airways** will offer 14 flights, all DC-7Cs with 59 tourist, 10 standard first and four de luxe seats. Last year Sabena flew 10 peak schedules in mixed DC-6Bs. Sabena is pushing Paris-Brussels helicopter service, finds its Russian tours popular.
- **SAS** increased its peak schedules by five for a total of 26. From New York, the airline will fly 17 all tourist DC-6B flights carrying 69 seats, nine DC-7C mixed schedules with 34 tourist and 12 first-class seats plus eight berths. SAS's Los Angeles-Copenhagen Polar route schedules this year will total seven, all of them DC-7Cs in mixed configuration.
- **Swissair** will schedule nine peak flights, up from seven last summer. One of them will be in DC-6B equipment, the others in the airline's new DC-7Cs. All flights will be mixed except one weekly all first-class schedule. Carrier will fly to Switzerland via Cologne/Bonn instead of Frankfort this year.
- **Trans-Canada Airlines** will offer 12 Super G flights with 54 tourist, four standard first-class, and seven de luxe seats. Total increase two.
- **TWA** will schedule 55 flights each way at the peak, an increase of five over last summer. No all first-class flights will be scheduled. Eighteen mixed Super C flights will seat 15 tourists, 15 standard first-class passengers, eight de luxe passengers, and will provide eight berths. Sixty-seat all-tourist Constellations will make up the rest of the schedules until introduction of the 1649As in July and August. "Jet-stream" flights will be all-tourist, seating 74.

New equipment on the Atlantic this summer will include the Douglas DC-7C, appearing in quantity on several airlines' schedules, and the Lockheed 1649A Super Star Constellation. The 1649A will go into Trans World Airlines service in June as the "Jet-stream," and into Air France service in August as the "Super Starliner."

Most airlines seem to be developing their existing package tours rather than adding many new ones this year. Trend is toward weeding out less profitable tours, strengthening and expanding the money makers.

Individual plans of the North Atlantic carriers this summer:

- **Air France** will offer a peak total of 24 flights each way, 16 of the mixed, seven all tourist, one all de luxe. Five of the mixed schedules will be new through flights from the U.S. continuing on from Paris to the Near East. Two of the 24 flights will originate in Chicago and fly via Montreal.
- **BOAC** will offer 24 flights, with seven all de luxe Stratocruiser schedules. Other schedules will be seven all-tourist DC-7C flights, ten mixed DC-7C flights. Two of the mixed flights will serve San Francisco this year.
- **Canadian Pacific Airlines** will make its debut this year in Montreal–Lisbon service. Four weekly DC-6B roundtrips will be offered on the airline's new route, all of them mixed flights. CPA also flies a Polar route from Vancouver to Amsterdam.
- **El Al Israel Airlines** will offer three Constellation flights a week, same number as last year, again all tourist. Airline hopes to have Britannia service by the last week in July, but is waiting to see what the Bristol workers' strike will mean in delivery dates. U.S. State Department's travel ban to the Mid East hurt El Al's bookings, especially for the Passover season which normally provides the airline with considerable business. Ban was lifted April 1, however, and El Al has experienced a strong increase in business. The carrier's Europe-Israel and westbound transatlantic business good all along.
- **Iberia** will schedule three Super G flights, same as last year. The Spanish carrier expects good business from IATA's General Meeting in Madrid this September, and from a travel agents meeting there in October.
- **KLM** will offer 24 flights, seven of them in DC-7C equipment with mixed first-class and de luxe configuration. Other flights will be 11 Super C all tourist schedules, three mixed Super G flights and three all-tourist Constellation flights. KLM expects to fly 100 transatlantic charters this summer.

KLM doesn't believe in mixing first-class and tourist passengers in the same airplane, holding that service is better and crew duties easier on single-class flights. The airline is making an exception this summer with three mixed flights serving Scotland and Ireland, in order to provide enough frequencies for each class of traveler for the summer season. When equipment permits, however, KLM wants to go back to the single-class schedules.

- **Linee Aeree Italiane** will schedule seven DC-6 and DC-6B mixed flights this summer, same total as last year. LAI is awaiting results of a reorganization before expanding its service.
- **Loftleidir** added a DC-4 all tourist schedule this summer for a total of seven. The airline is buying Lockheed Electras for the Atlantic run, expects delivery in 1959.
- **Lufthansa** cut its North Atlantic schedules this year from 11 to nine, all of them mixed tourist and de luxe Super G flights. Reduction resulted from transfer of some equipment to new routes to South America and the Middle East. The German carrier has ordered 1649As, with delivery beginning in late fall.
- **Pan American** increased its peak schedules from 75 to 77 each way. DC-7C, Stratocruiser and DC-6B seats will split 68% tourist, 32% first-class and de luxe. As of April 1, Pan American had booked 10,405 tourist passengers for June, an 11.1% increase over last year's bookings.

Transatlantic Flights

Summer 1957 Weekly Schedules (Peak)

(Each Direction)

	T	F	M	D	Summer 1957 Total Weekly	Summer 1956 Total Weekly
Air France	7		16	1	24	20
BOAC	7		10	7	24	19
CPA			4		4	0
El Al	3				3	3
Iberia	2				2	2
KLM	14	7	3		24	21
LAI			7		7	7
Loftleidir	7				7	6
Lufthansa			9		9	11
Pan American	21	9	45	2	77	75
Sabena			14		14	10
SAS	17		9		26	21
Swissair		1	8		9	7
TCA			12		12	10
TWA	37		18		55	50

T—tourist F—first class M—mixed class D—de luxe

CAB Issues Report On Canyon Collision

Washington—Civil Aeronautics Board issued its report last week on the mid-air collision between a United Air Lines DC-7 and a Trans World Airlines Constellation over Grand Canyon last June 30 listing probable cause as failure of the pilots to see one another in time to avoid the accident. Reason for the failure was not determined, but the Board listed these possibilities:

- **Intervening clouds** reducing time for visual separation.
- **Cockpit visibility** limitations.
- **Preoccupation with cockpit** duties.
- **Preoccupation with matters** unrelated to cockpit duties such as attempting to provide passengers with a more scenic view of the Grand Canyon area.
- **Physiological limits to human vision** reducing the time opportunity to see and avoid the other aircraft.
- **Insufficiency of en route air traffic** advisory information due to inadequacy of facilities and lack of personnel.

From an analysis of the wreckage, CAB determined that the initial impact occurred with the DC-7 moving from right to left relative to the Constellation.

It appears, the Board said, that the first contact involved the center fin leading edge of the Constellation and the left aileron tip of the DC-7. Immediately afterwards the lower surface of the DC-7 left wing struck the upper aft fuselage of the Constellation with disintegrating force.

The Board said this force caused complete destruction of the aft fuselage and destroyed the left wing outer panel. As this occurred and the aircraft continued to pass laterally, the left fin leading edge of the Constellation and the left wing tip of the DC-7 made contact, tearing off pieces of both. At the same time, the Board said, the DC-7 No. 1 propeller inflicted a series of cuts in the area of the aft baggage compartment of the Constellation.

From the extent of damage and the locations of various parts on the ground, the collision ripped open the fuselage of the Constellation from just forward of its tail to near the main cabin door.

The CAB said this accident apparently occurred in visual flight weather conditions and that there is no reason to believe the aircraft were not being operated in accordance with cloud separation criteria of visual flight rules.

Curtis Asks CAA, CAB Reorganization

By Katherine Johnsen

Washington—Basic reorganization of the functions of Civil Aeronautics Administration and Civil Aeronautics Board will be considered within the near future by the House and Senate Commerce Committees.

Testifying before the House Commerce Committee last week, Edward P. Curtis, special presidential assistant for aviation facilities planning, declared that the present governmental system for civil aviation is "extraordinarily complex and not very effective" and that "it is obvious the present system just doesn't work well."

Curtis Plan

Hearings are expected to begin shortly after the submission of recommendations for a board reorganization by Curtis. These are due the first week of May.

Urging passage of legislation to create a three-man Airways Modernization Board (AW Apr. 15, p. 29), Curtis emphasized that a more basic re-alignment of government organization for aviation should be a long term proposition. He said:

"The functions which the Board will perform are entirely in consonance with the considerations being given to a broader change in federal government organization in aviation matters. In my final report, I intend to cover the broader plan.

"However, it is now clear that much more thorough examination needs to be undertaken in order to achieve a durable permanent organization. To recommend such in final form too quickly might result in improvisations which would complicate or delay the expected action necessary to accommodate the civil and military needs of aviation in the future."

Congressional Skepticism

Curtis' proposal for the Airways Modernization Board will have to buck congressional skepticism over the creation of additional government agencies. Rep. J. Arthur Younger (R., Calif.) said at a session of the House Commerce Committee that, "It is the old American system of setting up another committee or board and thanking you have solved the problem."

Members of the proposed board would be the Secretary of Commerce, the Secretary of Defense and a third member who would be appointed by the President and not connected with any other agency of government.

Decisions would be made by majority vote, but some House Commerce Committee members expressed doubt that any one except the President himself could overrule a member of the Cabinet on matters affecting his department.

Meanwhile, the Air Line Pilots Assn. protested military encroachment of the airways to both House and Senate Commerce Committees. An ALPA report by Mel Logan, west coast regional air safety chairman, complained:

"The military is objecting to the establishing of every airway in the CAA long range program in this region. Serving the public interest in the minds of the military members of the airspace subcommittee, is serving the convenience of every branch of the military, before releasing any part of our diminishing air space for public use.

"A good look at the map today shows an unrealistic pattern of prohibited, restricted and caution areas plus the attitude of the military that every open area is a training area or planned training or potential training area. To further complicate this picture is the failure of the different armed services to share these training areas between themselves.

"The coordination and cooperation of our military units in time of war is a must and certainly would be ideal training in peacetime. We are at the point where more joint use of the air space is mandatory."

Developments at a House Commerce briefing session with CAB Chairman James Durfee were:

- **Durfee said the CAB will** consider a proposal by Rep. Walter Rogers (D., Tex.) that airlines be required to pay a "bonus" to passengers with reservations who cannot be accommodated on their flight. Rogers said that "if the airlines are going to impose fines for no-show passengers, it ought to work the other way, too." Durfee agreed that "some method should be devised to take care of the passengers."
- **CAB announced** that it will request legislation this session authorizing government guaranteed loans for local service airlines for equipment financing.
- **Committee chairman** Rep. Oren Harris (D., Ark.) and his committee will take steps to transfer military traffic, increasingly being handled by USAF's Military Air Transport Service, to commercial carriers.

Durfee agreed and said the portion of military passenger traffic handled by commercial lines dropped from 57% in 1951 to 18% in 1956 and that cargo and mail traffic dropped from 31% to 9% over the five year period.

CAB Opposes IATA Fare Plan

Washington—Civil Aeronautics Board opposition to the proposed passenger fare increases over the North Atlantic may mean a reduction in fares instead.

After the CAB voiced its opposition to the increase, a spokesman for the International Air Transport Assn. said transatlantic airline operators had agreed to follow a CAB suggestion to increase seating densities on their aircraft. Such a move, Board said, would permit a reduction in fares.

John Brancker, IATA traffic director, said the higher density seating arrangement is expected to go into effect by April 1, 1958.

5% Increase

IATA had urged governments of all airlines flying the North Atlantic to approve the proposed fare increase in the form of a 5% surcharge as an emergency measure to meet new increases in operating costs. The increase was to go into effect May 1 if the proposal received approval of all interested governments. The only opposition voiced was that of the CAB.

The Board announced it would defer action until April 25 so as to give any interested parties an opportunity to present arguments in support of or in opposition to, the proposed disapproval of the request for fare increases. It added, however, that under any circumstances it would find it difficult to justify an increase based upon seating densities and standards of service which the Board has repeatedly said it considers economically unsound.

Previous Order

At the same time the CAB referred to its order of last August in which the Board said proper development of international air transportation requires low fare service in order to make maximum use of the carrying capacity of modern transport aircraft (AW Aug. 27, p. 41).

The Board also said it is convinced that seating policies presently employed in tourist service do not reflect the maximum carrying capacity. "The most fundamental requirement of a proper and economically constructed fare structure, the CAB said, is the pricing of the low-fare service on seating configuration designed to efficiently utilize the aircraft capacity."

The Board added that it believes proper maximum seating density requirements would permit a reduction in tourist fares of about 10% without disturbing the current overall revenue position of the carriers concerned.

In the absence of such adjustments, the CAB said, the traveling public is deprived of lower fares that are both feasible economically and desirable in the interests of air transportation.

In deferring action on the proposed increase, the Board also expressed opposition to the manner in which the proposal was initiated. It said the agreement was initiated by IATA as an organization as opposed to the usual practice whereby a mail vote is requested by one or more carriers.

The Board said in its opinion that the initiative in the formulation of fare and rate adjustments should remain with the air carriers of IATA. It added that initiation of agreements by the IATA Secretariat appears unsound as a matter of policy and represents a type of price fixing procedure which the board considers objectionable.

Idlewild Will Admit Caravelle

New York—Turbojet transports got a foot in the hitherto tightly closed door to Idlewild Airport last week when the Port of New York Authority laid out a welcome mat for the turbojet Caravelle.

CAA announced that the Caravelle also will be permitted into Washington National Airport, so the French transport will be the first jetliner to operate from either of the two fields.

Port Authority's exact method of judging a jetliner's acceptability still remained vague, but the agency said it had sent an acoustical consultant team to Paris and it found the Sud Aviation aircraft no noisier externally than a DC-6 or Super Constellation.

PNYA had said (AW Mar. 4, p. 45) that Sud Aviation had requested permission to come into Idlewild but that more data on the Caravelle's noise characteristics was needed.

The Port Authority, which has barred from the airports it operates the Boeing 707 prototype, Comet 1A and II and any other jet that might jar its sensitive community relations, can still not talk about decibels or any other objective standards for accepting or refusing a jet transport. It won't say whether it studied the Boeing 707 as it did the Caravelle. It won't say specifically how the 707 violates its requirements.

Refers Question

All the agency will say on the subject is: "we must refer any questions on the noise characteristics of the Boeing 707 to Boeing."

The agency won't comment, either, on the cancellation by Executive Director Austin J. Tobin of a scheduled speech to the Society of Automotive Engineers National Aeronautic Meeting. Subject: Air Operations Problems in the Vicinity of Metropolitan Areas. Tobin, as a Port Authority spokesman, had enunciated frequently the anti-noise policy on jets.

Port Authority's reluctance to be more definite about noise level requirements may be motivated by concern for the future. If the Port Authority found it necessary to ease jets in later at noise levels not too different from present levels, any hard and fast definition of "acceptable" noise characteristics could be embarrassing.

Boeing's reaction to the news about Caravelle:

"We're very, very happy to hear about it—the more good publicity for jet transports, the better for the industry."

Boeing says some members of a Port Authority party took a few sound measurements during recent 707 tests at Seattle-Tacoma International Airport, but that a complete survey of the type done in Paris was not planned nor accomplished on the Boeing plane.

707 Noise Level

Bolt, Beranek and Newman, Inc., the consulting firm which studied the Caravelle for the Port Authority, have placed the Boeing 707 takeoff noise level at 130 decibels maximum overall sound pressure at 900 ft. (AW Sept. 3, p. 50).

Boeing said its suppressor work was going well and four prototype units would be flying in June.

Aviation Week asked a spokesman for the City of New York whether the Port Authority's stand on jet transports might jeopardize the city's future position as a leader in air transportation services. The spokesman expressed confidence that engineers would develop a silencer to solve the noise problem.

New York City has taken no direct or indirect action to change the Port Authority's position on jets as operator of the city-owned metropolitan fields, the spokesman said.

Sud Aviation reacted happily to the Port Authority decision and plans to bill the Caravelle as "the aircraft of tomorrow for the runways of today." The demonstration plane, which is the second Caravelle prototype, was scheduled to leave Dakar for Brazil last week on its tour of South and North America. Our May 2 schedule calls for a Caracas-Miami-New York flight.

The airplane is in a 54-passenger configuration with plush interior.

C-W Offers Airlines Olympus Jet Engine

Curtiss-Wright Corp., Wood-Ridge, N. J., will offer its version of the 16,000 lb. thrust Bristol BOL.6 as a powerplant for civil transports.

Curtiss-Wright said that the new two-spool turbojet, which it designates the Series 550, provides the necessary thrust for all-weather operation of commercial transports out of present airports. It will do this at better thrust-to-weight ratios and lower fuel consumption and noise levels than competing turbojets, Curtiss-Wright spokesmen claim.

Relatively low turbine inlet temperatures are being used for better engine reliability and longer life.

Because of these lower turbine inlet temperatures it is possible that the Series 550 engine is a derated version of the BOL.6 which has been type tested (the British parallel to U.S. 150-hr. qualification) at 16,000 lb. thrust.

For five years C-W has been working on the J67, a scaled-up 12,000 lb. thrust Americanized version of an earlier Olympus model, the 9,000 lb. thrust BOL.½. These efforts were under USAF sponsorship and it was hoped that the J67 would follow the success of the J65, the C-W import which the American engine builder patterned after the British Sapphire turbojet. However, the pace of the J67 development program was not competitive with the Pratt & Whitney J75 and the J67 has found its use limited to the Republic XF-103.

As part of its bid for the commercial jet market, C-W plans to demonstrate the series 550 publicly next month at its Quehanna, Pa., manufacturing and test area.

C-W will continue its engineering assistance agreements with Armstrong Siddeley in Great Britain and Daimler-Benz in Germany, according to C-W president Roy T. Hurley. In connection with Curtiss-Wright, Studebaker-Packard and Daimler-Benz agreement in the automotive field, Hurley said that C-W also expects to announce a joint C-W and Daimler-Benz project to cooperate in the field of jet engines.

The Wright-Bristol agreement also covers a number of other gas turbine engines.

British sources say Lockheed Aircraft Corp. is planning to evaluate the Bristol Orpheus engine as a possible powerplant for its entry in the USAF competition for a 10-passenger military and business executive jet transport. Presumably other entrants in this competition will also take a look at the Bristol engine and this could be linked with the Curtiss-Wright agreement.

X Pattern Breeds Efficient Schedule

By Glenn Garrison

Vancouver, B. C.—Flying a 31,000-mile international route pattern with seven airplanes calls for something special in the way of utilization. Canadian Pacific Airlines, with criss-crossing great circle routes that span a good part of the globe, ranks high among the world's airlines in undisplaced route miles if not in route miles flown.

Last year CPA carried 272,685 domestic and international passengers some 264,366,231 revenue miles. With its eye on the long-haul side of its business, the airline has big plans for the future.

A $20 million expansion program now under way includes purchase of five Bristol Britannia turboprops, a new hangar and other facilities at its Vancouver base, and an increase in personnel. Eight more DC-6Bs of an order of 11 are still to be delivered. And the airline is about to open a new route from Toronto and Montreal across the Atlantic to Lisbon.

But for the present CPA must serve its 29,718 miles of international routes from Vancouver to the Orient, Australia, South America and Europe with a fleet of seven DC-6B's. Inauguration in June of Toronto-Montreal-Lisbon service will raise the total to about 31,000 miles, and it will be September before more than seven planes are flying the entire network.

Maximum Utilization

Two factors particularly favor maximum utilization of CPA's long range planes:

• **X-shaped pattern** formed by the airline's longest routes, with its main base and maintenance headquarters at the center of the X.

• **Scheduling flexibility** provided by balanced seasonal characteristics of the route segments.

One stroke of the route pattern's X shape stretches from Australia via New Zealand, Fiji and Hawaii to Vancouver and on across a polar path to Amsterdam. The other stroke runs from Buenos Aires via Lima and Mexico City to Vancouver and on across the Pacific to Tokyo and Hong Kong. A shorter route breaks off the X at Mexico City and runs to Toronto. The new Lisbon service will extend this segment to Montreal and on over the North Atlantic.

CPA gets about 10.5 hrs. a day utilization from its DC-6Bs now, according to C. G. Rose, maintenance planner for the airline. Aircraft are scheduled so they end up at the Vancouver maintenance base near the 100-hour mark for inspection, C. G. Rose told Aviation Week.

Here's how the airline's planes can cover the major route segments and arrive at Vancouver at the right time for maintenance:

• **When Lisbon service** begins one DC-6B can fly from Vancouver to Mexico City, make two round trips between Mexico City and Lisbon, then return to Vancouver with 115 hours of flight time logged.

• **Another plane** will be routed Vancouver-Mexico City, make two round trips between Buenos Aires and Mexico City, then return to Vancouver at the 85-hour mark. The above two aircraft thus have provided two complete round trips between Europe and Vancouver and South America and Vancouver as well as two round trips between Mexico City and both Europe and South America.

• **A third** DC-6B can make two round trips between Vancouver and Hong Kong, arriving at its home base with 104 hours of flight time.

• **Fourth plane** will fly from Vancouver to Sydney, return to Vancouver, then make a round trip over the polar route to Amsterdam and back. Time 103 hours.

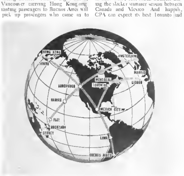
The Mexico City junction has the effect of increasing frequencies without adding aircraft. Thus a flight out of Vancouver carrying Hong Kong-originating passengers to Buenos Aires will pick up passengers who came in to Mexico City in the airliner from Lisbon.

Above scheduling, which accounts for only part of CPA's fleet, illustrates the extreme flexibility provided by the route pattern itself. Another big advantage is the balanced seasonal demand of the airline's routes.

Seasonal Schedules

From Vancouver, CPA now operates two weekly round trips to Hong Kong, two to Buenos Aires, two to Amsterdam, four to Honolulu, one to Sydney. In addition, there are four weekly round trips between Mexico City and Toronto. When Lisbon service is inaugurated May 30, three Honolulu schedules will be canceled, two Mexico City-Toronto flights will be dropped, two Amsterdam flights will be added and two Mexico City-Lisbon flights will be scheduled.

Winter is CPA's best season for Honolulu business, which tapers off during the warmer months. Polar route business to Amsterdam, on the other hand, is better in the summer. Therefore, pulling off Honolulu schedules and adding polar flights keeps the airplanes where the traffic warrants. Similarly, traffic between Toronto and Mexico hits a peak during the winter so the two schedules taken off that run in May won't cost much business during the slacker summer season between Canada and Mexico. And happily, CPA can expect its best Toronto and



CPA'S INTERNATIONAL ROUTES span 31,000 miles, with bands crossroads at Vancouver.

FIVE BRISTOL BRITANNIAS have been ordered by CPA for its long range routes.

Montreal to Europe business during the summer, when its new Lisbon flights begin.

As one-a-month deliveries of the DC-6Bs start in May, the airline will begin pulling three present planes out of service for overhaul at the rate of one a month. Thus, through August the effective fleet total will remain at seven and there'll be the new route to serve. But because of the seasonal situation, the pinch wouldn't be felt until fall, and by then the fleet will be bigger.

Besides its international runs, CPA operates 9,663 miles of domestic routes with a fleet of 14 DC-3s, eight C-46s, five Convair 240s, two Otters, one DC-4 and two Cansos—converted Catalina flying boats.

Unusual Situation

The airline's situation is unusual in two further respects, one favorable and one something of a handicap:

• **As a wholly-owned** subsidiary of Canadian Pacific Railroad, the airline enjoys a highly advantageous financial position. For one thing it utilizes facilities and services of the parent company's world-wide organization.

• **As a potential competitor** of government-owned Trans-Canada Air Lines, CPA is restricted by an official policy which keeps it off TCA transcontinental and overseas routes.

Of CPA's directors, only President G. W. G. McConachie and Executive Vice President R. W. Ryan are not also directors of the railroad corporation. When the airline needs money for equipment, it can go to the railroad and borrow it, which of course is a much less painful way to find capital than most airlines must use. The railroad, in fact, administers CPA's purchasing department, making possible a variety of economies for the airline. Many supply items become available to CPA at big savings—for example, airplane carpeting manufactured by a CPR subsidiary.

The railroad's public relations people, as another example, are assigned to subsidiaries such as CPA.

Canadian Pacific Railroad sales offices all over the world are tied in with the airline, and in many cases the parent corporation's three transportation services—sea, air and rail—are sold in combination.

Before World War II, Canadian Pacific operated a fleet of ships across the Pacific, all of which were sunk during the war. McConachie went to CPR's board of directors and convinced them that replacing the ships with airplanes would make better long-range economic sense even if there were losses to begin with. First CPA transpacific services were subsequently started with four Canadair 4s (DC-6s with Merlin engines).

Unfavored Position

The airline's relatively unfavored position with the Canadian government was highlighted during the moves which led to award of its new route to Lisbon. According to some reports, the government gave CPA the route only to eliminate an election issue. In so doing the Minister of Transportation reviewed government policy regarding the airlines' European operations: ". . . Trans Canada Air Lines is the Canadian air carrier designated by the government to operate transatlantic service to European points . . . CPA has been designated . . . to operate international scheduled air services from Montreal to Lisbon and also to Madrid . . . The government has reaffirmed its policy that TCA is and is to be the Canadian air carrier for service to other European points not at present served by a Canadian air carrier . . ."

If CPA's Lisbon/Madrid service were extended to Rome, it would link handily with the carrier's Polar route to Amsterdam and maintain the flexible route pattern.

McConachie told Aviation Week, however, that his airline has no intention of going to Rome—"that's TCA's." He also said there are no present prospects of a transcontinental route because he foresees no change in the government's position.

Expects Gross Increase

CPA's president feels the company has just "scratched the surface" in its development. He expects to do a gross business of $60 million in 1961, compared with a 1956 gross of "close to $30 million."

CPA's actual operating figures are not made public as such, being part of

C-46 modification is accomplished by CPA in its Vancouver maintenance headquarters.

the parent corporation's operation

McConachie was aboard a Britannia that lost an engine en route from Vancouver to Honolulu a few weeks ago and turned back to San Francisco. This didn't worry CPA's president, although the airline has five of the Bristol turboprops on order.

The incident "really sold me on the aircraft," McConachie said, adding that the plane's performance after an oil leak shut down one engine was "fantastic."

The Britannia, McConachie contends, will do anything a turbojet will do—only slower and cheaper." CPA has not ordered jets, but is "sitting and waiting—we're going to ride this panic out." He feels that CPA will suffer tough competition for a year or so against the jetliners, but can still order them in time for 1960 delivery when other airlines have gotten the bugs out of them.

"We've never bought an airplane that wasn't flying," McConachie says. He includes the Boeing 707 in the non-flying category because production models will differ from the prototype. CPA was ready to accept delivery of Comets for Pacific service just before the British jets were grounded.

Reciprocal Rights

The CPA official feels strongly that Canada and the U. S. should be much freer in granting reciprocal landing rights in their respective countries. The governments should "act like civilized people" and stop "all this poppycock" of stopping people at their borders, according to McConachie.

Examples of transborder routes CPA might consider profitable if rights were granted are Vancouver-Miami, Toronto to Los Angeles or San Francisco, Vancouver-Chicago, Toronto or Windsor to Honolulu, McConachie said.

McConachie raised a few eyebrows last year with a statement that he was "seriously considering" linking Australia and New Zealand with Europe via Argentina and the Antarctic ice cap.

He maintains that there's "nothing to it" operationally in flying such a route, but doubts that bilateral agreements could be achieved to make such service possible.

CPA's load factor on its international routes averages about 50%, the airline's president reports, and would be about 75% but for the addition of new routes. Polar route load factor is about 75% now, McConachie says, Vancouver-Orient runs about 63%, Australia route is about 45% and Vancouver-Buenos Aires is about 35%.

CPA discovered an unexpected traffic dividend in developing its Orient service—long haul business from the Far East to Latin and South America. Im-

AIRLINE OBSERVER

► Edward Curtis, Presidential aide for airways planning, is being urged by close associates to reconsider his plans to return to industry after completing his report on aviation facilities planning. Curtis has emphasized that the proposed new airways modernization board (AW April 15, p. 29) should be headed by a man with broad technical and operational experience, but colleagues believe that his political stature and high level connections would be more valuable in the new post than technical background.

► Airways Modernization Board recommended by Curtis parallels the organizational structure proposed last July for Air Navigation Development Board by Milton Arnold, vice president of the Air Transport Assn. (AW July 9, p. 40). Arnold, in testimony before the House Operations Subcommittee, urged the addition of a third member to ANDB who would be appointed by the President and confirmed by the Senate to sit with voting members of the Departments of Commerce and Defense as a means of breaking the ANDB deadlock. Arnold also suggested that a majority vote should be decisive just as Curtis has recommended for his board.

► Civil Aeronautics Administration is conducting tests on helicopter instrument flying in a move to advance scheduled helicopter service to an all weather operation and eliminate the necessity of the "see and be seen" principle for helicopters in high-density areas.

► Civil Aeronautics Board reported to the House Appropriations Subcommittee that its personnel complement had decreased from 684 in 1948 to 621 in 1956. Emphasizing the need for an increased staff, Board Chairman James Durfee told the group that 557 applications were pending on the formal docket as of Dec. 31, the majority of which involved route authorizations that had been on file for over three years.

► Qantas Empire Airways will make a new bid for a route across the U. S. to England. Australian Director-General of Civil Aviation, D. G. Anderson, will arrive in the U. S. next month to resume negotiations.

► Civil Aeronautics Administration post of assistant to the administrator for legislative affairs, vacant since it was authorized two years ago, was filled today when Preble Staver, former Air Transport Assn. assistant to the president, joined the CAA to take over the position.

► Capital Airlines last week operated a Waco 9 biplane powered with an OX-5 engine from Pittsburgh to Cleveland in commemoration of the company's 30th anniversary. The two-place aircraft is the same model first flown on Capital's basic air mail route and was piloted by Merl Moltrup who made the inaugural run April 21, 1927.

► KLM Royal Dutch Airlines claims to have handled more east-west transatlantic export cargo than any other carrier during the first quarter of 1957. Machinery accounted for the largest proportion of freight shipped by the airline and included agricultural implements, automobiles, aircraft and construction equipment. Textiles and wearing apparel ranked second.

► Air Traffic Controllers Assn. will propose a comprehensive educational program to help reduce existing confusion on proper rules governing IFR holding patterns. Controllers charge that both pilots and controllers are often not clear on proper holding pattern procedures. Confusion exists, they say, because there is no single reference on the subject.

► Deutsche Lufthansa Airlines has signed an interline agreement with eight steamship lines that permit passengers holding roundtrip transatlantic tickets to switch from air to sea or from sea to air on return trips.

► Civil Aeronautics Board Chairman James Durfee predicts that air travel will exceed railroad passenger mileage for the first time next year. Durfee told the House Commerce Committee last week that commercial airlines flew 22.3 billion passenger miles last year as compared with 23.6 billion passenger miles recorded by the railroads. The Board chairman forecast a continuance of the trend with the airlines moving into first place in 1958.

migration is a factor in this traffic, aided by the fact that Orientals can overfly the U. S. and thus obviate the need for any kind of U. S. visas. About 20% of CPA's Hong Kong-Vancouver passengers continue to Mexico or South America. Similarly, passengers on the Australia-Vancouver route continue to Amsterdam and thence to the United Kingdom (about 20% of them).

Reorganization

The airline's traffic and sales organization has been reorganized during the past year, according to Bryan Renwick, vice president-traffic. Increased sales efforts especially will be made in Eastern Canada as CPA enters this "biggest Canadian market" with service to Europe as well as Mexico and South America. Renwick feels the Lisbon-South America service is a "significant new route," linking the South American countries with antecedent countries in Europe such as Portugal and Spain.

All the airline's international flights are mixed, with tourists running about 4 to 1 over first class passengers, according to Renwick. Britannias also will be flown in mixed configuration.

CPA expects to hire 50 more pilots this year, for a total of 250. Personnel now total about 1,800 throughout the system, with 1,200 of them in Vancouver. The airline is spending $1.4 million on a new hangar and maintenance facility, which is scheduled for completion in time for the first Britannia delivery in September. Other expansion items include a $750,000 office extension and a $755,000 DC-6B simulator.

The airline is modifying eight C-46s formerly used in Dew Line operations as passenger-cargo aircraft for their northwestern services. The planes will seat 40 passengers.

Northwest Jet Order By August, Nyrop Says

Seattle—Northwest Orient Airlines expects to make a decision within four months on purchase of seven or eight Boeing Intercontinentals or Douglas DC-8s, Donald W. Nyrop, Northwest president, said here recently.

The long-range jets would be used in Seattle-Tokyo and Seattle-New York service, Nyrop said. They would enter service in 1960.

Purchase of eight to ten Lockheed Electra turboprops or four to five medium-range jets, such as the Boeing Model 707-120, also is reported under consideration for short-medium range assignments.

Northwest will double its hangar facilities at Seattle-Tacoma International Airport by 1960 at a cost of more than $2 million, Nyrop said.

Denial of Capital Family Fare Plan Recommended by CAB Examiner

Washington—Disapproval of a Capital Airlines family fare plan that extends the reduced rate to include Saturdays in addition to mid-week days has been recommended by Civil Aeronautics Board examiner Merritt Ruhlen.

The Capital tariff became effective March 30 when the allowable suspension period of 180 days elapsed prior to the completion of the CAB investigation of the petition.

Although the Board requested Capital to voluntarily postpone the adoption of the plan pending a final CAB decision, the airline chose to introduce the tariff with an extensive promotion campaign designed to attract Saturday family traffic.

In his initial recommendation, Ruhlen found the extension of the family fare plan "unduly preferential and prejudicial, unjustly discriminatory and unlawful." He did conclude, however, that the proposed fare falls "within the zone of reasonableness," and the bureau counsel held that the tariff is not unlawful.

If the Board upholds the examiner's conclusions, a CAB order for the cancellation of the tariff would now be required. American, Delta, National, Northwest and United have opposed the Capital plan.

How Plan Works

The family fare plan, which permits the head of a family purchasing a full-fare ticket to buy passage for each member of his family at half-fare, has been in effect over all routes of all trunk airlines since 1948. Passage with such tickets may be used only between Monday noon and Thursday noon. The Capital plan adds Saturday to the period that has fluctuated only slightly since its adoption.

In its petition on the revised plan, Capital argued that the addition of Saturday as a family fare plan day would divert a portion of its peak Friday traffic to Saturday, thus creating space for Friday's overflow traffic.

The airline estimated that the extension of the plan would increase annual passenger revenues by $571,272, net operating income by $255,598.

Capital said Saturday traffic was 26% lower than its average day traffic. Only 10% of its weekly traffic is carried on Saturdays, the airline said, as compared with 16% on Fridays. Capital added that Mondays are the second weakest day in terms of passengers.

Airline Opposition

American Airlines reported a similar pattern but other opposition carriers found Saturday to be a relatively strong traffic day. National Airlines said Saturday was second only to Sunday traffic-wise, with Wednesday developing the smallest volume of the week. Monday was found to be the weakest traffic day for Delta, Northwest and United.

In a check of its reservations cards at New York, American found that 31% of its first-class Saturday traffic consisted of family groups with 15% on Fridays and 20% on Sundays. In view of these findings, the airline estimated that if all Capital's family group traffic on Fridays and Sundays were diverted to Saturdays, it would lose $907,806 annually.

All opposing carriers complained that they would be required to adopt the Saturday plan if Capital is allowed to continue the tariff. American estimated the move would cause an annual diversion of between $700,000 and $2.5 million from its regular fare traffic.

United estimated a reduction of at least $672,000 in annual revenues if the family fare plan is adopted generally on Saturday.

In making his recommendation against the inclusion of Saturday in the plan, examiner Ruhlen suggested a CAB investigation of the over-all family plan. He added:

"In such an investigation, the Board should include as an issue the appropriate adjustment to be made in all passenger fares if the family fare plan is found to be unlawful. This could prevent a fare increase if the family plan were eliminated."

Delta Places Stock On N. Y. Exchange

Delta Air Lines last week became the tenth domestic trunkline to be listed on the New York Stock Exchange.

Of the 12 major U. S. trunk airlines, only Continental and Northeast, which are listed on the American Stock Exchange, are not yet included on the big New York board.

First trading of Delta common stock took place Wednesday following approval of the listing by the Securities and Exchange Commission and the New York Stock Exchange. The company's outstanding shares currently total 1,122,525.

Symbol of the airline on the ticker will be DAL. Lenart, McHugh & Co. have been designated by the Exchange as the specialists for the Delta stock on the Exchange floor.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

To Improve Aviation Now—Part I

The general emphasis on air traffic control for the future has tended to obscure the lagging development of our airports and landing equipment—a situation not waiting for invention but rather installation. Many air carrier cancelations, and most of the traffic jams, today can be laid on the threshold of these airports. The recent record breaking flight of the Boeing 707 illustrates our plight. Washington National couldn't handle the airplane. Idlewild wouldn't. Hence Baltimore. Our dreamy traffic control system of the future will be wasted until we begin at the ramp and work out.

To be sure, we can't go on pouring concrete and building "finger gates" forever. But to park X number of aircraft we need X number of square feet of ramp space—terminal capacity is no mystery. The airlines themselves could help here by doing everything possible to reduce the ground time per plane in order to increase hourly capacity.

Parking Area

Moving from the ramp to the runway we find that anything much less than 7,000 ft. of pavement today can best be classified as parking area. To handle the larger jets of the future we will need 10,000 ft. Therefore if you own a major terminal and wish to continue as such it is heartily recommended that you provide at least two runways of the appropriate dimension.

Next we paint. All ILS runways should come equipped with CAA TSO N10A Runway Paint Marking. And please fellows, it won't last forever so do keep a brush and bucket handy.

Now electricity. ILS runways should be adorned with modern high intensity edge lighting using 100 ft. longitudinal spacing. This means ANC Type C-1 lights or equivalent. Actually narrow gauge flush runway lighting is probably the coming vogue but exact installation data will have to wait for final flight tests.

Need we mention approach lights? Complete configuration A (centerline) systems plus flashers should be attached to each ILS runway. Where real estate does not permit the full 3,000 ft., put in as much as possible. If you have a sheer cliff at the end of the runway, provide configuration A threshold marking plus two condenser discharge lights like those tested and used on Runway 31L at Chicago Midway.

Also, if you contemplate uninterrupted big plane service at your terminal, two complete ILS and approach light systems are needed. Cross country barnstorming to complete a circling approach is simply not the way to operate modern aircraft.

Adequate Visual Aids

The standardization of these handy little guides to finding a runway can hardly be overemphasized. All effort and money involved in the airplane, its flight, the traffic control system, the radio aids, the ILS and the gaudy terminal might as well be poured down the drain if the pilot is not provided with adequate visual aids for landing. These visual aids must be considered as much a part of the ILS as the glide slope and localizer. Their design and installation should not be left to local option.

An integral part of the landing system also is the cockpit instruments. To this end there must be a change in existing CAR to permit use of the new "T" panel. Omitting this has the same effect as forgetting the approach lights or any other essential ingredient.

The plea for most of these items is not new. On and off for the past six years substantially the same requirements have been outlined in this column. For the past six years very little has improved at the local aerodrome. How can we possibly discuss supersonic travel via push button control in 1970 when we don't even make use of existing know how?

SHORTLINES

► **Boeing Airplane Co.** senior vice president Wellwood E. Beall predicts that European airlines may double the orders for jet transports they now have with U. S. companies. Beall says most of the carriers with jets on order will have to increase their orders to meet route commitments and that carriers with no present orders will have to place them soon.

► **Pan American World Airways** will begin daily first class-tourist combination service between New York and Lisbon on April 28. Douglas DC-7Cs will be used on four flights without refueling stops at the Azores. The remaining three flights will use Douglas DC-6Bs. The new service will be scheduled into Lisbon and continue on to Barcelona, Nice and Rome. Pan American will begin daily tourist flights from New York to Nassau with Douglas DC-7Bs on April 28.

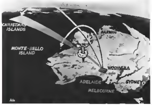
► **Braniff International Airways, Inc.** will inaugurate Douglas DC-7C service between the U. S. and Latin America on May 16. The new twice weekly flights will operate out of New York to Washington and Miami by interchange agreement with Eastern Air Lines and continue to Panama, Lima, Sao Paulo and Rio de Janeiro. The service will be a first class-tourist combination.

► **United Air Lines** will operate a new "men-only" flight between New York and Chicago beginning April 28. The new flight will feature steak dinners, closing market quotations, pipe and cigar smoking.

► **American Airlines** will offer Douglas DC-7 service from Boston to Cleveland and St. Louis beginning April 28. Effective May 1, the airline will begin DC-7 Mercury service from Boston to Chicago and San Francisco with a scheduled flight time of 10 hr., 20 min. Both flights will be on a first-class basis.

► **United Air Lines** will construct a $2 million hangar at Newark Airport with completion scheduled for the middle of next year.

► **Northwest Airlines** will begin Douglas DC-7C service on its Seattle-Tokyo route beginning April 28. With this new service the airline will offer daily service over its transpacific route for the first time. The DC-7Cs will operate on a four round trip a week schedule. The remaining three schedules will be flown with Lockheed Super Constellations. Northwest will have all DC-7Cs on the transpacific route by fall.



MAP SHOWING Woomera location in relation to Sydney, Melbourne and Adelaide. Mushroom burst is sited on Maralinga, permanent atomic test site.

UPPER ATMOSPHERE research vehicle Skylark is loaded into 58 ton launching ramp. Missile will reach 120 mi.

HARP (High Altitude Rocket Projectile) commonly known as Rockoon will be fired from Woomera during International Geophysical Year.

British Speed Woomera Missiles Work

Adelaide, South Australia—Soviet Premier Bulganin's scarcely veiled missiles threat at Suez-time and Britain's new and revised defense concept has goaded the country's guided weapons industry into a burst of energy.

Word has gone out officially that top priority is to be given to IRBM and ICBM projects.

The order also was passed to extend Woomera Range to give maximum over land distance. This will be up to roughly 1,300 mi. (IRBM range), and eventually clear to the Indian Ocean Christmas Islands. (As distinct from the similarly named Pacific group where the U.K. megaton bomb tests are to be held next month), a distance of roughly 4,000 mi.

The recent U.K.-U.S. summit talks cleared the way for Britain to accept some U.S. guided weapons to tide over the immediate need, but this, at the best, can only be a temporary measure. For one thing the radar network which will control Britain's outer defense ring is widely different than U.S. system and consequently extensive adoption of missiles other than those built expressly for the U.K. hookup cannot be made without considerable problems—and expense.

It seems highly likely, therefore, that any U.S. weapons adopted as a result of the Washington and Bermuda talks will be of a type which do not rely on or fit into the radar scanning system.

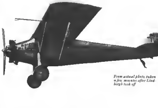
But, why is Britain in the position where she has to shop abroad for hardware when, for 10 years or more, she has been designing and developing missiles of her own?

Basically, the answer goes back to 1947 when staff planners at the U.K. Defense Ministry figured there would be no global war requiring guided weapons, as then epitomized by the German V2, within 10 years.

The planners figured that intermediate weapons could be obviated and a limited budget conserved if a long range policy could be adopted with something like 1957-8 as the target date for weapons to replace the bomber, fighter and anti-aircraft guns.

Broadly, the U.K. system of getting a guided missile from the idea stage to operation is along these lines:

- The British Air Ministry, thinking in terms of the next stage of aircraft development and the necessary armament (in the case of air-to-air weapons, say) studies the overall requirement and sets out its views and general specifications.
- The Supply Ministry approaches a number of manufacturers whom it thinks capable of carrying out such a project.
- From the replies, and over conference



From actual photo taken a few minutes after Lindbergh took off

LINDBERGH Lands in Paris on Goodrich Silvertowns

SILVERTOWNS across the sea! Landing on the dependable resilience of Silvertown Airplane Tires Capt Charles E. Lindbergh in his Ryan monoplane "Spirit of St Louis" won his fight with death and distance The stalwart cushioning of Silvertowns absorbed the landing shock of the first airship to fly from New York to Paris without a stop.

Silvertowns started Lindbergh safely on his way past the dangerous, critical seconds of the take-off at New York

Silvertowns delivered him safe at Paris — safe from the fateful impact as his eagle plane swooped from the sky and slammed its wheels down on Europe

The first thirty seconds of the flight — the last thirty seconds of it!

The first 1,000 feet on the ground after Lindbergh cried "Okay" and they jerked the chock blocks away from the Silvertown-shod wheels! The last 1,000 feet as the great monoplane hurtled across the Paris landing field

These were seconds of held breath and tense nerves. Would the tires stand up as the 5,150 pounds of the loaded plane hammered and battered them along the runway? Would they hold the 46-foot wingspread of the eagle ship true to the course?

Would a tire fail in those seconds of grave stress? A blowout spelled the end of the magnificent venture, perhaps with a still greater adventure for the man in the cockpit.

Less than a minute of time yet an eternity of suspense the overseas plane thundered along the gauntlet of disaster

Silvertowns held! Their sinewy strength, their sturdy cushioning stood the stress and strain that had doomed a thousand flights Capt. Lindbergh soared away safe and landed safe

Silvertowns met the test as they met it when this unheralded challenger Capt Lindbergh, started on his flight from San Diego to New York and made it in less than twenty-three hours

The dash through the clouds to Paris was a matter of gasoline, courage of the intrepid voyager of the skies — and Silvertown tires in the taking off over here and the landing over there.

The "Spirit of St Louis" sped overseas a perfectly equipped airplane, instruments and parts the nearest to perfection ever assembled.

Captain Charles Lindbergh built it quietly at San Diego, counting on its mechanical perfection as well as his skill and courage to carry through to the goal

And when it came to tires he fortified the security of his plane with Silvertowns He underwrote the safety of his venture with the tires that have through years met the test of great moments of competition

He called to his aid the same flexing strength, the same dependable endurance with which Goodrich Silvertowns have for years served the motor cars of the world.

The B. F Goodrich Rubber Company, Akron, Ohio

Goodrich Silvertowns

BEST IN THE LONG RUN

This ADVERTISEMENT appeared in June, 1927

Now pilots land all over the world on B.F. Goodrich Tubeless

THE MOST SIGNIFICANT development in tires since Lindbergh's flight is Tubeless, pioneered and patented by B. F. Goodrich. Now in service with overseas airlines and military planes, B. F. Goodrich Tubeless sets the pace because it saves weight, performs better

B. F. Goodrich Tubeless Tires are making greater payloads possible by reducing weight as much as 120 pounds per plane. And while saving weight, BFG Tubeless Tires offer superior air retention, save time and money in warehousing and maintenance. That's why the trend is to B. F. Goodrich Tubeless.

B. F. Goodrich Tires "cross the Atlantic" again on a replica of the SPIRIT OF ST. LOUIS in the Leland Hayward—Billy Wilder motion picture production of Charles A. Lindbergh's Pulitzer Prize-winning story, "THE SPIRIT OF ST. LOUIS", ... with JAMES STEWART as Charles A. Lindbergh, presented by WARNER BROS.

B.F.Goodrich

AVIATION PRODUCTS
A division of The B. F. Goodrich Co
Akron, Ohio

HIGH ALTITUDE control test vehicle (CTV) is one of basic research missiles in use at Woomera. Missile has sustainer motor. Rocket boosts shear away at burnout

tables where necessary, one or sometimes more of these private firms are asked to go ahead and produce a test vehicle with specific accent on tolerances, size, weight and space allocation

- If this meets with Ministry approval a number of pre-prototype models are requested for more extensive examination and testing
- Prototype models follow to iron out remaining bugs
- Production is ordered with the trials of these units being carried out by service teams from the armed services

One Accepted

Final acceptance depends on satisfactory progress through all these stages. To date only one British weapon has been officially announced as being accepted—the air-to-air Fairey Fireflash. The system, rigid and exacting, is similar to that observed for aircraft production. Perhaps the major difference is that few, if any, missiles develop as private ventures. A missile manufacturer is not aware of the overall defense program and the vast sums involved preclude indiscriminate wildcatting on the chance that something worthwhile might develop

Reimbursement

A cost-plus system is adopted for reimbursement of manufacturers' efforts whether the project is successful or otherwise. Initial testing is carried out in most cases on the U.K. ranges at Aberporth and Larkhill or in South Australia at Woomera. Backing up the vast Woomera Range, now in the process of being extended with its advanced tracking network, is the Weapons Research Establishment at Salisbury, near Adelaide, South Australia. Considerable resources are available here for checking and proving firing results

Adjacent to WRE branches of the major U.K firms engaged in the missile industry have been set up involving the employment of possibly the most highly trained technical work force in the Commonwealth

De Havilland, one of the oldest established companies in the guided missile field, is one of the major contractors. It is widely accepted, although not officially announced, that DH is developing an air-to-air weapon for fighter armament using what is generally regarded as a reasonably efficient infrared target seeking system of guidance. Short-ranged but of high speed, the weapon is almost certainly solid fuelled. It is known the weapon is well advanced and into the air trial stages and it could well be the next weapon to be unclassified in the AA division

It was recently announced that Saunders Roe is to be associated with DH in a new project. The exact nature of the marriage was not announced but Supply Minister Howard Beale used the term "manyfold" in announcing a major expansion program. It is known that SR recently completed a new wind tunnel capable of Mach 3 and as the company is not known to be contemplating building an aircraft in this speed range, it is suggested that the new venture could be a joint effort leading to a new surface-to-air missile, or even the initial stage of the IRBM

Fireflash

Fairey Aviation was the first British firm to become established at Salisbury and Woomera. It produced the Fireflash air-to-air weapon, now undoubl

edly being used as a training combination with Hunter and Swift fighters in the UK and with Avon engined Sabres in Australia

Fireflash is a fairly simple dart whose propulsion is gained from twin boost rockets positioned above and below the missile itself. At burnout, when a high supersonic speed is reached, these motors shear away leaving the unpowered beam riding missile to coast freely for several miles

Vickers-Armstrong missile, which fell by the wayside, was the air-to-air weapon which this company was developing for arming the Gloster Javelin Mark 1. Whether the aircraft or the weapon was untimely was not disclosed when the contract termination was announced last year

It can be said officially that Armstrong Whitworth is currently developing a naval guided missile, the contract being with the British Admiralty and not as is normal, with the Supply Ministry

The missile is believed to be well advanced although by no means near the production stage. Sperry is associated with the control system and General Electric is engaged on the guidance work

The missile has been extensively tested at Woomera and it would follow that the next trial stage will be from the newly commissioned HMS Girdleness, the Royal Navy's first missile ship

Bristol Rise

Bristol has risen rapidly into the limelight in recent years and is today heavily committed to the guided weapons program. Knowledge of the company's Thor ramjet makes it obvious that its role is the development of a surface-to-air missile with a substantial range, using Thor as a sustainer motor assisted in take-off by rocket motors. Its speed is well into the Mach plurals, its range limited only by fuel-carrying capacity. Cheapness of the ramjet—one estimated puts it at about £1,000—adds to the rosy future which the company has in this field. The electronics company of Ferranti are known to be associated with the guidance and control systems

It has been claimed that English Electric is one of the few British groups able to carry out entire production of a missile—if not the only group. Currently engaged on production of a surface-to-air missile tests are extremely encouraging. The company has an extensive trials team on the Woomera Range. Napier is associated on power and Marconi on guidance. The missile consists of a main rocket surrounded by eight boosts arranged in pairs giving a formidable take off speed

A V Roe, only recently established in Australia, is believed to be undertaking Britain's first venture into the air to surface field. One line of thinking suggests that the company's own Vulcan V bomber might be the aircraft to be linked with the missile

Emi Engineering Development Ltd, a branch of the world wide musical and instrument company, is not engaged on a missile itself, but is an important ancillary unit providing much of the electronics and telemetry systems for range trials. It is also believed to be active on proximity fuse work

Geography

Woomera is both a town and a range, the products of a joint UK-Australian agreement signed in 1946, and on which, to date, Australia has spent something like £60 million and Britain possibly twice that figure. Nearest capital city is Adelaide, 300 miles southeast, an outer suburb of which is Salisbury where the range's base facilities and laboratories are situated.

Woomera village comprises 500 or 600 permanent brick, timber, or aluminum homes, a school, hospital and theatre, and enjoys its own power supply, water drawn through a 250-mile pipeline, and normal social services. Here live the technicians and scientific staffs of both the private companies who test their weapons on the range and the

government staffs who control the range

A sizeable single men's area caters largely for construction workers and barrack style camps provide accommodation for troops of the three services who have need to learn the missile operating and handling techniques.

It is of interest to note that the present Range Superintendent is a Royal Navy captain he having succeeded an Army general and an Air Force group captain

The village is flanked to the northwest by an all weather, heavy-duty airfield with capacity to handle major maintenance and repairs to aircraft ranging from the Valiant V bomber used for high level ballistics trials, through Superforts Canberras, Meteors, veteran Mustangs and Beaufighters, to Jindivik, the pilotless jet target aircraft designed and developed by the Australian aviation industry

This airfield is the range terminal for the 'pipeline' courier service which has operated for nearly 10 years bringing missiles for testing, equipment for installation and missilemen out from the UK

Forward Base

Forty miles further northwest lies the forward base of Koolymilka and adjacent, the firing pads, launching ramps and instrumentation blocks into which filter the down-range recordings of flying missiles

To even enter the village of Woomera a pass is needed special dispensation is required to get beyond the street limits, but at Koolymilka, a road block, armed guards and man proof fences bar progress to all but those entitled to pass forward

Initially, the range extended only 45 miles fanning northwest over dead-flat gibber-strewn red desert, speckled with native saltbush on which sheep thrive 20 to the square mile Annual rainfall is 8 inches and that usually in three or four downpours

Temperatures run as high as 120F regularly in the summer shade, and as low as 40F in the winter nights But the clear skies, infrequent wind storms and long hours of daylight make weather conditions the most perfect in the world for missile testing

Today, the range extends for some hundreds of miles—no one will admit the exact limit Concrete pillboxes housing radar-controlled cameras electronic tracking instruments and measuring equipment stud the flight line every few miles Late last year an aerial survey was completed to carry the range through to the West Australian coast and, spurred by the present urgency, construction workers are pushing ahead day and night with a road to follow this route

Construction of monitor posts tele

graph links, staging camps and installation of equipment is scheduled to follow in fiscal 57 8, by which time Britain hopes to have weapons requiring at least that range limit It has already been admitted officially that one missile powered by Bristol's Thor ramjet, has exceeded the present range limits

Authority controlling the range is a departmental body known as Weapons Research Establishment (WRE), answerable directly to the Department of Supply in Australia and to the Ministry of Supply in the U K

What little official light is shed on activities both at Woomera and Salisbury is usually jointly released by Supply Minister Howard Beale in Australia and his counterpart, Aubrey Jones, in the UK WRE, in effect, is responsible for creating and maintaining the facilities with, or on which, a dozen private British aviation and engineering firms carry out trials of their weapons or weapons systems

Data Processing

These companies have been given accommodations in a former wartime munitions plant area adjoining WRE's Salisbury headquarters, the whole of which is under close security They receive from their U K plants the missiles for testing, usually in knocked down form, assemble them and use their own teams for actual range firings Evaluation of results is supplied to the contractor after data processing on WRE's electronic computors.

These computors are also widely used to synthesize problems on behalf of contractors

Unlike the U S system whereby a missile project is given a colorful code-name almost from its inception—a name which quickly becomes a byword in the industry—the U K system does not disclose publicly even a hint of a name In fact, while a secret code-name is applied throughout the design, development and testing phases, supposedly known only to those associated with the program, a completely different name is given to the finished hardware An instance of this was the Fairey Fireflash air-to-air fighter armament weapon officially cleared last year Its development code name was a vastly different, seven-letter alias

WRE does not stop at providing facilities for others It has a number of branches of its own undertaking pure research into propulsion systems, equipment design, avionics, development of test vehicles in association with Royal Aircraft Establishment (RAE) Westcott, U K, and is currently installing the most powerful wind tunnel in the southern hemisphere of Mach 3 capacity It has produced high-class gyros on the one hand and huge transporter units on the other, but its primary role is

that of providing the means for proving the products of private enterprise.

These products include a number of air-to-air weapons, surface-to-air and surface-to-surface missiles and there is growing proof that at least one air-to-surface weapon may be under way. Current firing programs are a long way short of the range's capacity.

No official figures have been given of the work load at Woomera, but it is known that the rate could be stepped up perhaps tenfold before causing embarrassment. Night firings, for instance, are rarely undertaken and there is generally a wide stand down at weekends.

One estimate of operating costs has been put at £10 million a year, but just what this includes or leaves out puts the figure into the guesstimate class. Total personnel engaged in the industry, private and governmental, probably approximate 10,000, the majority of whom are governmental.

Standing behind the private companies established at Salisbury, of course, are the parent companies and groups, including Fairey, English Electric, General Electric of England, Armstrong Whitworth and Bristol, solidly committed to the guided weapons industry to the tune of millions of pounds and employing many thousands. And behind them again, stand more than 400 smaller companies subcontracting to the weapons which have been suddenly jerked into Britain's defense program.

Radiation Increases Efficiency of Fuel

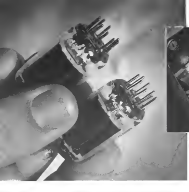
Intensely radioactive gold can increase the burning efficiency of fuel by 50%, a University of Michigan chemist, Stuart W. Churchill, told the American Chemical Society annual meeting in Miami last week.

In an experiment sponsored by USAF Office of Scientific Research, effects of different types of radiation on combustion were tested by engineers of the university at a site at Willow Run airport. Stream of propane, directed though a one-ounce nest of gold wire .003 in. diameter, was the first test to show a strong reaction, largely because of the intense strength of the gold radiation—rated at 10,000 Curies.

Other fuels would behave the same way as propane, the experimenters believe, and they found the results the same for all fuel-air mixtures tried and at atmospheric pressures equal to 30,000-50,000 ft. altitude.

Professor Churchill said the discovery might mean nuclear radiation could give small engines the thrust of larger ones with a significant weight saving, or that existing engines could attain higher altitudes.

The gold lost most of its potency



within three weeks, leaving no waste problem. However, the question of shielding remained. The experimenters used thirty tons of bagged cement and 1½ tons of lead sheet around the apparatus. Even then 20 engineers were needed for the project, because work had to proceed 24 hr. a day and each individual could remain in the area only a short time.

USAF Missiles Facility Moved to Norton

Los Angeles—Ballistic missiles logistical support functions, now located at Maywood Air Force Depot, will be transferred to Norton Air Force Base at San Bernardino, Calif., in the near future because of overall economy measures. Col. Philip B. Foote becomes deputy commander for ballistic missiles at Norton, and will head the ballistic missile management group.

In the new assignment Col. Foote will report to Gen. E. W. Anderson, commander of the San Bernardino Air Materiel Area and will receive directional control from Gen. Ben I. Funk, who is deputy director for ballistic missiles, Air Materiel Command, and chief of the ballistic missiles office at Inglewood, Calif.

The ballistic missiles office is one of three team members of a military-civilian management team carrying out the ballistic missile program for the Air Force. Ballistic missiles office is responsible for procurement and production, supply, maintenance engineering, quality control and transportation in the ICBM and IRBM program for Air Force Western Development Division of ARDC, the team managers, and the guided missiles research division of Ramo-Wooldridge Corp.

New Company Formed In Rocketry Field

Los Angeles—Era Engineering, Inc., Santa Monica, Calif., has been formed for development of new systems and equipment in rocketry and electronics.

Era Engineering already announces these three systems now available:

• Simple system for measuring distance between missile and target in near miss situation. System will assess effectiveness of missiles under experimental firing conditions, make available data to firing crews immediately after impact.

• Device for measuring erosion of missile surfaces under hypersonic environments. (Projected is a system for measuring and recording thickness of skin material as a function of time.)

• Radioactive recovery technique for missiles and components after experimental firings.

DELEGATION FROM Hungarian People's Republic views new transport, IL-14, during a meeting held at Moscow airplane factory.

New IL-14 Much Improved Over IL-12

(The article below was written for Grazhdanskaya Aviatsiya, the magazine of Aeroflot, Russia's airline, and is being reprinted in Aviation Week *because of the growing importance of the IL-14 in Russian civil transport. In addition to going into large scale Aeroflot service, the airplane is being presented by the Soviets to the leaders of such countries as India, Yemen and Iraq to gain goodwill and political advantage)*

By Engineer-Pilot V. Bragin

The IL-14 aircraft is a cantilever, low wing monoplane with retractible landing gear and nose wheel, and a single fin empennage. Its fuselage is of semi monocoque type with stressed skin. It is distinguished by a long, streamlined configuration.

The following geometric characteristics of the wing exert a great effect on the plane's flying and operating characteristics: the planform, the relative thickness of profile, the span, the aspect ratio, etc. The wing was derived from a modified TsAGI SR 5M profile. Its relative thickness, that is, the relation of maximum height to chord, is 18% at the root and 12% at the tips. For comparison we recall that the relative thickness of profile for the IL-12's wing is 16 and 10%, respectively. The TsAGI SR 5M profile, as compared with the IL-12 wing profile, provides a considerable reduction in the wing's profile drag with the same lift qualities.

In plan, the wing has a trapezoidal shape and a sweepback angle of 3 degrees. Thanks to the sweepback, there is a component of the speed of air flow directed along the wing span from the ends to its root section. The breaking up of the flow at large angles of attack is moved from the end section to the root section, which exerts a favorable effect on the plane's lateral controllability and improves the work of the ailerons.

The wing area is 100 square meters. Its size answers an important requirement of aerodynamics to ensure low landing speed along with a comparatively high cruising speed. For the IL-14, these indices are 140 and 358 kilometers per hour. Loading on the IL-14's wing is 172.5 kilograms per square meter. Aspect ratio is 10.

The engine nacelles are streamlined in shape. The exhaust stacks do not protrude outward but are inscribed in the contour of the nacelle. The air intakes are also concealed. The exhaust stacks are brought out to the trailing edge in the decompressed zone.

Because of the improved aerodynamic characteristics of the wing and nacelles the IL-14's cruising speed is increased by 15 to 20 kilometers per hour as compared with the IL-12. Closing the landing gear doors while the gear is extended improves the takeoff characteristics and, in addition, permits horizontal flight and even a slight gain in altitude near ground level with one operating engine when the propeller of the non-operating engine is feathered.

ANGLES OF ATTACK AND AERODYNAMIC EFFICIENCY (LIFT-DRAG RATIO)

ANGLES OF ATTACK IN DEGREES	IL-14	IL-12
0	4,85	2,65
2	9,9	5,8
4	12,4	8,4
6	13,2 *)	9,9
9	11,8	10,0 *)
12	9,9	9,9

* OPTIMUM ANGLE OF ATTACK

Time required for retracting the landing gear is 5 seconds in the summer and 6 to 7 seconds in the winter.

The IL-14's wing mechanization consists of two split flaps with an overall length of 18.8 meters, which is 59.3% of the wing span. With deflection of the flaps 20 degrees, the aerodynamic efficiency (lift-drag ratio) of the plane in the range from minimum speed to a speed of 175 kilometers per hour is more than with undeflected flaps. Therefore, the action of the flaps in the wing's operation is very effective.

The sturdy vertical empennage, the correctly-chosen lateral V of the wing and the large span of the ailerons ensure good lateral stability and controllability.

The increase in the area of the vertical empennage is due chiefly to the larger rudder. Its greatest angle of deflection on both sides is 25 degrees. On the rudder is a spring compensator by which the loading on the leg in single-engine flight is decreased and the plane's lateral controllability is improved.

The area of the horizontal empennage is increased by 6% as compared with the IL-12 aircraft.

In the range of operational balance from 13 to 18.6% mean aerodynamic chord the plane has adequate longitudinal stability and controllability.

Anti-Icing

In order to prevent impairment of the plane's aerodynamic qualities due to icing, the leading edges of the wing, the stabilizer and fin, the propellers, and the front glass of the cockpit have anti-icing devices.

Takeoff power of the ASh-82T engines used in the IL-14 is 1,900 hp at 2,600 rpm, and manifold pressure of 1,250 millimeters of mercury column. This is 50 hp more than the forced power of the ASh-82FN engines used in the IL-12. Takeoff power to an altitude of 400 to 500 meters is kept constant. In case of failure by one engine after the IL-14 has achieved a speed of 160 kilometers per hour, when the landing gear is in retracted position, prompt feathering of the propeller will permit continuation of the takeoff.

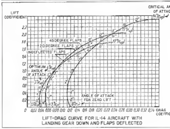
Examination of the flying and operating data on the IL-14 shows that it boasts advantages over other piston powered planes used in civil aviation. The principal advantages are: high cruising speed, safety in takeoff, good single-engine flight characteristics, adequate stability and controllability in all flying regimes, and high payload capacity.

For a detailed acquaintance with the main aerodynamic characteristics of the

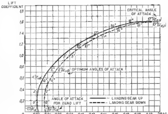
ANGLES OF ATTACK AND AERODYNAMIC EFFICIENCY (LIFT-DRAG RATIO)

ANGLES OF ATTACK IN DEGREES	UNDEFLECTED FLAPS	20 DEGREE FLAPS	45 DEGREE FLAPS
—8	—	—	0
—6	—	—	1 7
—4	—	1 9	3 79
—2	—	6.3	6 4
0	5 28	10 4	7,9
2	11,3	12.7	8,8
4	13 96	13,2 *)	9,2 *)
5	14 3 *)	12 8	9 1
6	13 8	12 6	8 9
8	13,2	11 5	8 64
10	11,9	10,4	8 3
12	10 8	9 5	7 8
14	9 7	8 5	6 95
17	7 8	—	—

* OPTIMUM ANGLES OF ATTACK



LIFT-DRAG CURVE FOR IL-14 AIRCRAFT WITH LANDING GEAR DOWN AND FLAPS DEFLECTED



LIFT-DRAG CURVE FOR IL-14 AIRCRAFT WITH RETRACTED AND UNRETRACTED LANDING GEAR (FLAPS NOT DEFLECTED)

IL 14 we will examine the plane's lift-drag curve with retracted landing gear and undeflected flaps (p. 65) in gliding regime with negligible thrust.

As is evident, the following aerodynamic data correspond to the plane's characteristic angles of attack. The angle of attack for zero lift (a_0) is 1.5 degrees. At the same time, the coefficient of lift (C_y) is zero, and the magnitude of the coefficient of drag (C_x) is 0.023. The angle of attack which corresponds to the minimum coefficient of drag, that is, the flight regime at maximum speed, is 0.6 degrees, and the magnitude of the minimum coefficient of drag is 0.021.

Coefficient

It should be mentioned that the coefficient of minimum drag is an index of a plane's aerodynamic efficiency. For the IL-14, its magnitude is comparatively small. Thus for the Yak 12 (single-engine trainer—Adam) the minimum coefficient of drag is three times greater.

The optimum angle of attack for the IL 14 (d_{HB}) (d_{HB} in illustration p. 65) is 4 degrees. At this angle the aerodynamic efficiency (lift-drag ratio) has the greatest magnitude—18.1.

The critical angle of attack (d_{kp}) is 17 degrees. The maximum value of the coefficient of lift in the given instance is 1.6.

For the IL-14 as compared with the IL-12, the magnitude of the optimum angle of attack is 2 degrees less, the aerodynamic efficiency is three units greater, the range of angles of attack is 1 degree greater, and the maximum magnitude of lift coefficient at the critical angle of attack is greater.

What advantages do these indices give to the airplane?

In flight, with retracted landing gear and undeflected flaps, the IL 14 has a greater range of speeds, less required thrust and power, etc.

We will examine the characteristics of the IL-14 in flight with extended landing gear and deflected flaps (p. 65). The drag coefficient for the IL 14 with extension of the landing gear increases by a magnitude of 0.013 (for the IL 12 by 0.024). Such a small increase is explained by the fact that after the landing gear is extended, the compartments are closed by doors. As a result, the plane's aerodynamic efficiency, with extended landing gear, for the entire range of angles of attack (speeds) is more than for the IL-12.

With deflection of the wing flaps, the profile curve is increased, the air stream breakup is delayed, and the wing's airflow is improved. At the same time, the value of the lift coefficient increases, but simultaneously in still greater degree the drag coefficient increases, and thus the plane's aero-

dynamic efficiency decreases at all angles of attack For landing the flaps are deflected an average of 25 to 30 degrees Their full angle of deflection is 45 degrees

Shown in illustration p 65 is the lift-drag curve of the IL 14 with extended landing gear and flaps deflected at 20 and 45 degrees In addition the corresponding data are cited in table

Range Rises

Thus by deflecting the flaps 20 degrees, the angle of attack of zero lift is decreased to minus 4.5 degrees, the optimum angle of attack is 4 degrees, and the efficiency drops to 13.2 The critical angle of attack decreases to 15 degrees, but the lift coefficient increases by 0.26 and is 2.03 instead of 1.77 The range of angles of attack from zero to critical rises and is 19.5 degrees (−4.5 − +15) Correspondingly, the plane's range of speeds rises

On takeoff with flaps deflected 20 degrees, the speed of leaving the ground (145 kilometers per hour) decreases due to the increase in lift coefficient In addition, the takeoff characteristics improve because, for angles of attack corresponding to speeds from starting takeoff to 170-180 kilometers per hour, the plane's efficiency with flaps deflected 20 degrees is greater than with undeflected flaps

When the flaps are deflected 45 degrees, still greater changes take place in the IL 14's aerodynamic characteristics, namely the angle of zero lift decreases to minus 8 degrees, the optimum angle of attack is 4 degrees with simultaneous lowering of the aerodynamic efficiency to 9.2, the critical angle of attack decreases by 3 degrees but the maximum lift coefficient increases by 0.52, and the range of angles of attack from the angle of zero lift to critical rises and is 22 degrees Correspondingly, the plane's range of speeds increases From the lift drag curve it is evident that the aerodynamic efficiency at all angles of attack decreases since with deflection of the flaps 45 degrees the coefficients of lift rise in lesser degree than the coefficients of drag

The decrease in aerodynamic efficiency is accompanied by an increase in glide angle in landing The lift coefficient for the landing angle of attack rises, which provides a decrease in landing speed and the drag coefficient rises, leading to faster loss of speed after reducing the engine power for landing Consequently, deflecting the flaps while gliding increases its steepness and lowers the speed faster before landing Whereupon the landing speed itself decreases and, thereby, the length of the landing run also

The IL-14 lands at a speed of 135 kilometers per hour with flaps deflected 45 degrees Landing speed with undeflected flaps is 145 kilometers per hour.

In the event of violent head winds or of strong side winds, it is recommended that the landing be made without flaps or deflect them 20 degrees.

Two German Sites Chosen As Nike Missile Bases

Bonn—Two bases for the air defense missile Nike will be built in Ebernberg near Landau and in Baumholder Allied plans, not yet finalized, also provide for rocket bases near Bad Kreuznach and Simmern. All four bases are in German Rhineland Palatinate

Northrop Establishes International Division

Hawthorne, Calif.—Northrop Aircraft, Inc., has established a new division known as Northrop International which will be responsible for all overseas programs of the company

J Gilbert Nettleton Jr, formerly vice president customer relations for the Radioplane Co, was elected corporate vice president responsible for the new division.

His offices will be at 9756 Wilshire Blvd., Beverly Hills, the new corporate headquarters after May 1.


THIS MACHINE IS THE MASTER OF A FLEET OF JETS
IBM
705
ELECTRONIC DATA PROCESSING MACHINE

Navy Airplanes Show Good Availability

By Richard Sweeney

El Centro, Calif.—High order of reliability of fleet use airplanes, especially in ordnance and avionics, was apparent during Navy weapons meet here.

Predominant problem was foreign object damage to Curtiss-Wright J65 turbojet engines in North American FJ-3 Fury fighters during landing and takeoff despite cleaning of active runways. Clean taxiways, ramp areas, use of intake screens, reduced foreign object damage considerably, but landing-takeoff situation remained biggest headache.

Using Aero 5A and Aero 5D fire control systems on Grumman F9F-5 and F9F-8 respectively, and the Mk. 16 system on the FJ-3, all utilizing the APG-30 ranging radar, competing squadrons were operating proven equipment. Avionic problems were few and random, none unexpected.

Mk. III 20 mm. cannons were used in F9F airplanes, Mk. 12 guns in the FJ-3. Guns are identical in basic operation, prime difference being an air feeder for the Mk. III, a windup feeder for the Mk. 12.

Supplies Materiel

Fleet Air Gunnery Unit (FAGU), based at El Centro Naval Auxiliary Air Station, provided all support materiel for units competing in the meet, furnished towed targets and pilots, and supported airplanes involved in fire power demonstrations. Competing squadron maintenance personnel did all actual work on aircraft, drawing needed equipment replacement items from FAGU stock. FAGU supply officers drew approximately 30 day normal supply of spares, which were expected to be consumed within the projected seven firing days of the meet.

Overall, aircraft were firing better than 93% of loaded ordnance per mission. Target hits also were running to numbers indicating good quality marksmanship of pilots.

Eight Navy squadrons and three Marine squadrons participated in the competition, in which units either competed in air-to-air or air-to-ground phases, but not both. Of these, four Navy units and two Marine units competed in aerial gunnery while four Navy and one Marine unit competed in air-to-ground gunnery and bombing.

In air-to-air gunnery, three Navy units, two from Miramar and one from Oceana flew FJ-3s, one Navy unit from Jacksonville flew F9F-8s, one Marine unit from Cherry Point flew F9F-8s, and one Marine unit from El Toro flew F9F-5s.

In air-to-ground gunnery and bombing, one Navy unit from Jacksonville flew AD-6s, another Navy squadron from Jacksonville flew F9F-8s, one Marine unit from Edenton flew ADs, and two Navy squadrons from Moffett flew ADs and F9F-8s.

Mixture of Navy and Marine units, various types of both jet and prop driven aircraft, gave indication of wide scope on combat potential in all classifications.

Demonstrations

During meet, daily firepower demonstrations were held, including first public displays of Navy LABS using Chance Vought F7U Cutlass. First displays of Navy LABS system were made during press cruise of USS Forrestal, but at that time, Grumman F9F-8s were used. This was first indication that F7U has atomic capability.

Other demonstrations:

- **Second** public firing of Navy's large Zuni rocket (AW Mar. 11, p. 26).
- **Salvo** firing of 194 2.75-in. rockets air-to-ground by prop driven AD Skyraiders.
- **Firing** of multiple external stores (rockets, "special shapes"), by McDonnell F3H-2N Banshee.
- **Aerial** display for of new Westinghouse Aero 13F (all weather) fire con-

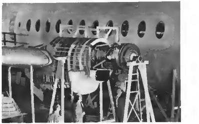
P.1B Makes First Flight

English Electric P.1B twin jet fighter made its first flight only a week after British announced defense policy changes which will shorten its production life. It will be last fighter British will build. Air defense missiles will succeed manned fighters, according to British policy (AW April 15, p. 27). Powered by two Rolls-Royce Avon engines, P.1B is first British fighter supersonic in level flight. Fuselage was redesigned to accommodate more powerful Avon engines (P.1A had Sapphire) and radio, radar and armament including missiles and 30 mm. Aden cannon. Cockpit, equipment is cooled to overcome kinetic heating effects of high speeds. P.1B is all weather day and night fighter, was high rate of climb, can cruise economically on one engine.

trol system in Douglas F4D Skyrays. Skyrays were flown by Naval Test Center pilots from Patuxent River, who went "under the hood" shortly after takeoff, accomplished remainder of mission through firing passes blind.

Aero 13F is not yet in fleet use on F4D but was designed for incorporation on retrofit basis on Skyrays now in fleet and Marine use. System is packaged so that mounting is on rail in the circular nose of F4D, enabling maintenance to be performed by simply removing the plane's nose cone, sliding out avionic gear on the rail.

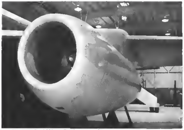
• **First use** of newly developed special explosive charge which yields mushroom cloud, loud noise and sprays dirt about simulating fallout, like a tactical atomic bomb. Two were to be set off during meet, one during a firepower demonstration on gunnery range, other close to El Centro base itself. Developed by Bermite Powder Co., Saugus, Calif., charge was planned to familiarize Navy personnel on land bases and shipboard to physical characteristics of tactical nuclear weapons without danger of radioactivity.



Mockup on Tyne Vanguard

Trans-Canada Air Lines engineers inspect a mockup of the Rolls-Royce Tyne turboprop being installed in the starboard inner nacelle of the full-scale Vickers Vanguard mockup at Weybridge, England. Engine, rated at 5,315 eshp., is scheduled for Vanguards on order for Trans-Canada Air Lines, with delivery scheduled to start in 1960.

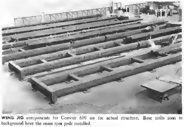
Ground rules of weapons meet, second such staged by Navy and with twice the number of competing units and expanded events (last year's consisted of only aerial gunnery) were similar to those of recent Third Marine Air Wing meet (AW, Mar. 25, p. 33) in that only unit personnel could touch competing planes and once a competing plane broke ground on takeoff, it was committed and charged for the mission regardless of the cause if an abort occurred in aircraft, avionics or ordnance.



MOCKUP DETAIL of 880 nacelle. Transport will use commercial version of J79

Convair 880 Details

DOUBLE-SLOTTED Fowler-type flaps, shown on 880 mockup, will be used



WING JIG components for Convair 880 are for actual structure. Base units soon in background have the main spar pads installed

New Rotor and Hub Tested for Bell XV-3

New two blade rotor and a simplified hub is being tested for Bell's XV-3 tilting rotor convertiplane near Ft Worth, Dallas Two blade semi rigid rotor, which will replace current three-blade configuration (AW April 15, p 23), is being evaluated on a whirl test stand by Bell Helicopter Corp New rotor can be utilized because of improvements in the basic kinamatics of the semi-rigid rotor, according to the company

A major factor in this design advance is Bell's recently developed underslung feathering axis (UFA) hub, also used on the turbine powered XH-40 and being tested on the Model 47.

Test program, which will include stability and stress investigation on the whirl stand and a 100 hr approval period, is being started following receipt of a supplemental agreement from USAF, which is administering the XV-3 program for the Army

A second set of the new rotor system will be installed on the No 2 Bell XV-3 and the aircraft will be flown by Military Air Transport Service to Palo Alto, Calif, for advanced tests in NACA's 40 ft x 80 ft full-scale wind tunnel Wind tunnel phase will be followed by Phase II flight tests

C-46 Weight Boost Approval Sought

Miami—L B Smith Corp is seeking Civil Aeronautics Administration approval of a boost in gross takeoff weight of its C-46 modification to a 50 000 lb airplane Designated the C-46 CW20-T, it is presently CAA approved at 47,650 lb.

The Miami firm says a dozen of the modified C-46s now are in operation, seven are undergoing re-manufacture, and several more are on order Experience has shown, according to L B Smith, that the airplane has capabilities for the 50,000-lb gross Few changes in present modification are expected to be required

Riddle airlines last month announced CAA approval of a C-46 modification the cargo carrier has developed at its Miami base (AW Mar 25, p 29) Riddle is pushing sales of its "C-46R" modification to short-haul carriers

If L B Smith's new gross is approved it will top Riddle's by 100 lb

Other performance figures announced by the firms 225 mph cruise speed, 1,635 mi range 45-55-passenger capacity for the Smith conversion 235 mph top true air speed, 1,600 mi range, 50 passenger capacity for the Riddle conversion

Air Transport FACTS AND FIGURES

18th EDITION

1957

PREPARED BY

AIR TRANSPORT ASSOCIATION OF AMERICA

1107 SIXTEENTH STREET, N. W., WASHINGTON D. C.

THE JOB AHEAD

This book is a record of the past In these factual and statistical columns you will find a dramatic story of air transport progress But the men and women of the scheduled airlines, both by inclination and necessity, seldom dwell on the accomplishments of the past In 1957, the scheduled airlines of the United States stand on the threshold of the civil aviation jet age. This revolution in transportation may well revise drastically the pattern of our economic and political and social life.

So far as the airlines are concerned there is no turning back By the end of 1956 they had committed themselves to more than $2,600 000,000 to be spent over the next 5 years for new turbo-prop and turbo jet airliners that will move people and cargo faster, accelerate the mails and add new and more powerful wings to our national defense.

But to bring these benefits to the public, the airlines face new and complex problems, both technological and economic, that have been thrust upon them. At stake is our nation's world leadership in aerial commerce and the very feasibility and vigor of its air power, in peace and war.

Most immediately critical is the problem of air navigation and air traffic control We have almost run out of a precious natural resource, the air space itself. In addition, the air traffic control system is inadequate to handle even today's air fleet. More radar and other known electronic aids must be employed to provide some interim improvement of the present system. But beyond this, we need a whole new system concept geared to the traffic of tomorrow, that will increase rapidly in numbers and complexity, to provide adequate control of all air traffic at all times Of course, any modern system must contemplate the unique and elaborate demands of the military and so must be far more expensive than civil aviation alone requires

Equally important is the need for improvement and development of our nation's airports, those highly valued gateways by which each local community will enter or maintain its position in the air age.

These problems of adequate air traffic control and airport facilities are everybody's for they are concerned with vital service to the nation's air defense, our air transport network, the growing fleets of business aircraft and the private flyers.

The airlines are concentrating on better service for passengers and cargo but they face a serious economic barrier. This problem magnified itself in 1956 For the 19th consecutive year the scheduled airlines set new records for public usefulness Revenue ton-miles flown—the yardstick by which we measure the usefulness of air transport—increased 15 6 per cent for the entire American-Flag scheduled air transport industry But even though the industry's total revenues hit an all time high of $1,861,175,000, an increase of 13.9 per cent above 1955, the net operating income after taxes was 7.2 per cent below 1955 due to continuing rising costs in all phases of airline operation. This steadily narrowing gap between growth and net income means that the airlines are becoming progressively more vulnerable financially.

The grim fact is that constant technological improvements and intensive management efficiency, which built today's vast airline network, are no longer sufficient to combat the inflation trend of our nation's economy. This has focused attention anew on the fare structure of the airlines.

Since the passage of the Civil Aeronautics Act of 1938, the birth certificate of the organized scheduled air transport industry as we know it today, the airlines have maintained a policy of swallowing cost increases to keep fares low. Actually air transportation today costs the air traveler less per mile than it did in 1938. During this same period, while the average fare has been held down, the industry has doubled—and in many instances tripled—its usefulness in every phase of its service to the public

The revenue problem is complicated by regulation. Scheduled air transport is the most closely regulated and highly competitive public service industry there is and competition is constantly increasing. For instance, new service has been authorized between 320 pairs of cities during the past two years Further, in the case of 64 city pairs, already served by two, three or four competing airlines, more service was added Beyond this, at the end of 1956, 33 foreign carriers were flying into this country in direct competition with many of our own carriers for overseas business.

The fare and airline cost problem will be in the spotlight for months to come. One thing is certain—to hold the fare line at the expense of improvements in service is not in the best interest of the public or the air transport industry.

The scheduled airlines also must constantly improve equipment because of their responsibilities to our national security. The airlines feel they can provide an even greater contribution to the national defense than is presently provided for in the Civil Reserve Air Fleet (CRAF) program if they are permitted to perform a greater share of the routine carriage of military personnel and cargo This will permit the Air Force to devote more of their trained men and resources to such combat activities as SAC and ADC, reduce the over all load on the taxpayer, and create a greater airlift potential in case of national emergency. These beneficial results can be obtained if a closer working partnership is developed with the military.

The job ahead is to unscramble these problems and face the future with the competence and confidence that have enabled the U. S. scheduled air transport industry to build the largest, finest, fastest and safest air transportation system in the world.

FACTS AND FIGURES

18th Edition, 1957

This index covers material demonstrating the increasing use of U S scheduled air transportation in the post war years. Revised data filed by the scheduled air carriers with the Civil Aeronautics Board and the records of the Interstate Commerce Commission served as the major sources of the statistics

Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN Total seat miles available for sale in scheduled service

AVAILABLE TON MILES Total ton miles of lift capacity available for sale in scheduled and charter service

CHARTER FLIGHT Transportation of passengers or property on other than scheduled and designated extra section flights

EXPRESS TON MILE A ton of express flown one mile

FREIGHT TON MILE A ton of freight flown one mile

PASSENGER MILE. One passenger flown one mile

PASSENGER LOAD FACTOR The percentage of available seat miles actually sold in scheduled service.

PASSENGER TON MILES Passenger miles converted to ton miles (See definition of revenue ton miles)

REVENUE PASSENGER MILES The number of fare paying passengers flown times the length of trip in miles. This is the amount of available seat miles sold

REVENUE PLANE MILES Aircraft miles flown in scheduled service

REVENUE TON MILES The ton miles sold in scheduled and charter service. In the construction of this traffic measure passenger miles are converted to ton miles on the basis of about 10 to 1 That is ten passengers with allowable free baggage are accepted as equalling one ton

SEAT MILE. One passenger seat, filled or unfilled flown one mile

TON MILE LOAD FACTOR Percentage of available ton miles sold in scheduled and charter service

U S MAIL TON MILE A ton of mail flown one mile The statistic includes priority air letter mail and air parcel post Since the beginning of the experiment on flying first-class (three cent) mail by air such non-priority mail has also been included in U S Mail Ton Miles

Revenues and Profit and Loss

EXPRESS REVENUE Revenues accrued from the carriage of express

FREIGHT REVENUE Revenues accrued from the carriage of freight.

INCOME TAXES Federal income taxes

NET INCOME BEFORE TAXES The net income to the business from all transactions In addition to airline net operating income this includes such items as net profit from the sale of equipment proceeds from the ownership or sale of investments, revenues of separately operated divisions revenue from the rental or contractual operation of aircraft and profit or loss on the exchange of foreign currency

NET OPERATING INCOME The total operating revenue from air transportation services less the operating expenses (see definition of Operating Expenses) Net Operating Income is before taxes and interest charges and does not include the nonoperating items in Net Income Before Taxes (see above)

NET PROFIT OR LOSS Net income after Federal income taxes—the amount available for dividends or investment in the business This figure is subject to change because of the later adjustment of some accounting transactions and through revision of mail rates and subsidy by regulatory action

OPERATING EXPENSES The expenses incurred in the conduct of the business except for such items as debt financing and other non-operating items identified above in Net Income Before Taxes

OTHER REVENUE All other revenues including excess baggage chartered services foreign mail penalties for failure to cancel reservations service charges on non-revenue transportation of employees and special services such as photography and crop dusting

PASSENGER REVENUES Passenger revenues from scheduled operations

PUBLIC SERVICE REVENUES Payments by the Federal Government to insure air service to communities in the United States and its territories which could not otherwise afford it to maintain essential international air routes which are not yet self-supporting, and to develop helicopter service

U S MAIL REVENUE Service revenue for the transportation of mail This is the amount paid by the Post Office to purchase air transportation for mail and is not subsidy

EVER-GROWING
PUBLIC USEFULNESS
SINCE 1938

All classes of Certified Air Carriers	1938	1956	percent increase
Number of Airlines	23	54	135
Cities Served	286[1]	713[1]	146
Airplanes in Service	345	1,726	400
Seats Available (Daily)	4,930	89,500	1,577
Cruising Speed of Fastest Transport	220	360	64
Number of Passengers Carried	1,536,900	45,943,000	2,891
Number of People Employed	13,300	126,976[2]	855
Total Airline Payrolls	$27,396,000	$429,517,200	2,178
Air Mail Ton Miles	7,449	94,542,000	1,169
Average Fare[3]	5.32c	5.29c	—0

1 These figures include international cities as well as domestic points and 10 Hawaiian cities. In addition 241 Alaskan points were served in 1956 and 12 in 1938 making a total of 954 cities in 1955 compared to 298 in 1938.
2 As of 6/30/56.
3 Domestic Trunk.

COMMERCE

The scheduled airlines of the United States today fly more than 61 per cent of the entire free world's air passenger traffic.

Under a doctrine of regulated competition established by the Civil Aeronautics Act of 1938 the airlines have built the finest, fastest, most reliable and most competitive—as well as the safest—air transportation system in the world.

Progress in Equipment

The combined fleets of the nation's scheduled airlines by the end of 1956 totaled 1,726 aircraft, representing an investment of more than half a billion dollars.

Speeds have increased. In the time it took the air traveler in 1938 to go from New York to Chicago, today's passenger can fly all the way from New York to Denver.

Capacity is greater. Biggest of today's four-engined airliners can carry five times as many passengers as the twin-engined airliners of 1938. Passenger wise, all of today's airliners could provide seats for every man, woman and child in a city of 89,000 population. At the same time, they could carry 3,116 tons of mail, express and freight.

Progress in Services Provided

In 1938, half the nation's total population was without any air service at all. Today the nation is spider-webbed with airline routes tying together some 546 U. S. cities, big metropolitan centers and small rural areas. International operations link the U. S. with some 157 cities in 58 different foreign countries. Few localities are without air service of one kind or another.

Competition is increasing. There are almost three times as many certificated scheduled airlines today as there were in 1938. Over all domestic revenue plane miles flown are up 352 per cent today over the 1938 figure. The average number of daily plane miles flown for all domestic and territorial airlines in 1938 was 198,000. The figure was 1,354,000 in 1956.

The number of airlines serving individual cities has increased greatly since 1938. Today as many as 18 carriers serve the major terminals like New York and Chicago. In fact, in the past 17 months, competition between carriers was greatly intensified. Competition was added to one third of the air traffic of the United States with as many as six additional carriers certificated to operate between two cities. In fact, from one to six additional carriers were certificated for 320 city pairs.

The value of the services which the airlines perform is indicated by increased spending on airline travel. In the past ten years, for example, the American public has demonstrated its faith and acceptance of air transportation by buying airline travel at a greater average yearly rate of increase—18 per cent—than any other type of personal purchase.

Safety has helped build this public confidence. In the ten years from 1947, airline accident fatality rates have shown a drop of almost 80 per cent. Moreover, safety record comparisons show that air travel is, in fact, five times as safe as riding in your own automobile.

What the public is buying today in air transportation is a post-war luxury service at pre-war fare levels. In 1939, the airlines' first full year of operation under the Civil Aeronautics Act, an air passenger paid $44.95 for a ticket from New York to Chicago. (There was only first class service available.) Flying time was four hours and 35 minutes. Today's air traveler can make the same trip using air coach or air tourist services for only $33.00, a reduction from 1939 fares of more than 25 per cent. The flight takes only two hours and 55 minutes. And today's passenger—whether first-class or coach—rides in an airliner that is far superior to the best of 1939.

Progress Toward Self-Sufficiency

In 1939 mail pay in the form of subsidy or public service revenue, was a major source of airline income. By comparison, in 1956, public service revenue paid to the airlines represented only 2.3 per cent of their gross income. The domestic trunklines were almost entirely free of subsidy.

And mail pay is no longer a form of subsidy. In fiscal 1939, the domestic scheduled airlines grossed $47,633,759. Public service revenue or subsidy represented 25.9 per cent of this amount.

By comparison, in 1956, public service revenue paid to all the airlines represented only 2.3 per cent of their gross income. The domestic trunklines were almost entirely free of subsidy. Only the local service airlines, certain segments of international routes, the territorial airlines and the new helicopter services still receive public service revenue.

Milestones of 1956

The scheduled airlines carried their 300,000,000th passenger in 1956. Behind this statistic is a far more significant fact than the number itself. It took 24 years for the airlines to carry the first 100,000,000 passengers, four more years to count the second 100,000,000 but only a little over two years to hit the 300,000,000 mark.

Comparing 1956 figures with 1955, the number of passengers carried showed an increase of 10.4 per cent. In 1956, for the second time since the end of the Korean action, the scheduled airlines were solely responsible for a 3.5 per cent increase in the domestic intercity passenger traffic carried by the country's commercial transportation system.

The year showed gains in every type of service which the airlines provide. During 1956, the airlines carried 152,098 ton-miles of air mail, an increase of 10.7 per cent over 1955. Air express shipments increased from 51,285,000 ton-miles in 1955 to 52,278,000 ton miles in 1956. Air freight jumped from 382,847,000 ton-miles carried in 1955 to 434,256,000 ton-miles carried in 1956.

In the twelve month period, the airlines added 238 airliners to their combined fleets, increasing their capacity to airlift passengers mail express and freight by 15.6 per cent.

During the year the industry grossed $1,856,231,000, an increase of 13.6 per cent over the previous year. But, although each individual carrier did more business, operational earnings failed to follow suit, and in some instances losses appeared. Profit margins still lagged substantially behind other public service industries.

At the same time, the industry has committed itself to an additional $2,600,000,000 in orders for more piston-engined aircraft and new jet liners. By year's end this total number of new aircraft on order totaled 670.

DOMESTIC TRUNKLINES

The domestic trunklines during 1956 carried 81.3 per cent of the total number of passengers who flew on the scheduled airlines. Passenger business for the domestic trunks was up 11.8 per cent and accounted for 90.4 per cent of the total trunkline revenues.

Air coach and air tourist services accounted for 35.9 per cent of the domestic trunkline passenger traffic. First-class service saw a rise of 12.6 per cent.

The trunklines also carried 60.3 per cent of the total air mail ton-miles. Carriage of the mail, by the ton-mile yardstick, was 6.6 per cent over the previous year's figures.

Air express ton miles showed a gain of 0.2 per cent. Total air freight movements on a ton mile basis showed a gain of 9.5 per cent.

During the year public service revenues dropped 18.2 per cent from the 1955 figure and amounted to less than 2 of one per cent of their total revenues.

INTERNATIONAL

U. S. Flag Carriers during 1956 accounted for 65 per cent of all passengers between the U. S. and foreign countries. During the heavy vacation travel months of June, July and August, the airlines flew more passengers to Europe than went by surface vessel.

The year's totals showed a 10.2 per cent increase in the number of passengers arriving via American international carriers from foreign countries. At the same time, the number of passengers they carried abroad was 10.1 per cent higher than in 1955.

Air coach and air tourist travel to and from the U. S. increased by more than 19 per cent during the year. The low-fare flights accounted for 64 per cent of the international passenger business. First-class traffic increased 9 per cent.

There were also important changes in the international route structure during 1956. The CAB, in permitting two of the U. S. overseas carriers to fly an inter-change operation across the Pacific, in effect, gave the U. S. a second round-the-world air route. One new foreign airline was granted entry into the U. S. and began operations. Another foreign airline began flying a trans-polar service with terminal points in the U. S. Of the total $42,736,000 in public service revenues granted the scheduled airlines in 1956, $8,128,000 went to the international carriers to fly routes in the government's interest.

LOCAL SERVICE

Created as a whole new family of airlines just after the end of World War II, the Local Service Carriers celebrated their tenth full year of operation in 1956. The decade produced many measurements of progress.

By the end of 1956 they had carried 100 times the number of passengers in the past twelve month period as they carried ten years ago. The gain in passenger traffic over 1955 was 21 per cent. Likewise, they have increased their gross revenues eight times since 1947. The increase in 1956 over 1955, was 17.7 per cent with total revenues in last year amounting to $67,380,000.

Although the local service airlines carried only one per cent of the total mail tonnage in 1956, it is significant to point out that without them some 192 U. S. cities would be without any direct air mail service.

The fact that they are making such a contribution to the nation's postal and transportation system accounts for the larger slice which they receive from public service revenue. In 1956 this figure was $22,933,000. The previous year it was $20,714,000. Indicative of their growing importance, however, is the fact that ten years ago they carried 25,000 pasengers, while in 1956 they carried 3,453,000—an increse of 13.712 per cent.

HELICOPTER CARRIERS

In 1956, scheduled helicopter airlines carried a total of 63,000 passengers and 135,000 ton-miles of mail and other cargo. Passenger service showed a gain of 152 per cent over 1955. During the year new and larger helicopters were put into operation. The helicopter passenger, used to riding in a rotorcraft with a capacity for carrying only five persons now can ride in helicopters that can carry 12 passengers. Although a limited number of new helicopters went into service during 1956 the number of seats available on a daily basis increased 98 per cent.

Because it costs more to fly a ton of passengers, mail or cargo by helicopter than it does to airlift the same load in a DC-7 airliner, the helicopter services are getting 5.6 per cent of the public service revenue dollar to help expand their operations. In 1956 this subsidy amounted to $2,544,000. However, public service revenue dropped 6.1 per cent from the 1955 figure.

ALASKAN CARRIERS

During 1956 Alaskan carriers, stimulated by new business in support of the DEW line radar network, showed 31.4 per cent increase in total revenue. Available ton miles increased 52.4 per cent over 1955. Biggest traffic increase was in charter flights which jumped 151 per cent. The total number of passengers carried showed a 19.3 per cent increase. There was an 11 per cent increase in subsity.

TERRITORIAL CARRIERS

Over-all revenues for the Territorial Carriers in 1956 showed an increase of 4.4 per cent while subsidy declined .7 per cent from the 1955 figure. Total passenger revenue was up 6.3 per cent. Freight revenues increased four per cent from the 1955 level. Charter traffic was off 47.1 per cent. Mail showed an increase of .9 per cent.

ALL-CARGO AIRLINES

The all-cargo airlines in 1956 carried 13.3 per cent more freight traffic than they did during the previous twelve-month period. Available ton-miles of the all-cargo carriers increased from 184,521 in 1955 to 284,512. Charter business accounted for the greatest gains in the all-cargo field, 42 per cent of the total revenue ton miles flown. This was an increase of 242 per cent over 1955.

MAIL

The Civil Aeronautics Act of 1938, also said that the scheduled airlines must serve the postal system of the United States.

Since then, public use of the air mail service in the United States, which the scheduled air transport industry provides under contract with the Post Office Department, has increased 1,169 per cent. The airlines, for example, carry today in 50 days the number of air mail letters that they carried in fiscal 1938.

In the beginning, carrying out their responsibility of speeding the mails, the scheduled airlines relied heavily on public service revenues. This was a major source of revenue for the young industry. In 1956, however, total mail pay received by the whole scheduled airline industry amounted to only 3.4 per cent of the industry's gross revenue.

More important is the way the revenues from the air mail stamp are split today as compared with the breakdown in 1938. Then the airlines got 94.5 per cent of the stamp revenue, the Post Office kept 5.5 per cent. In fiscal 1956, the airlines got 17.2 per cent of the stamp revenue, while the Post Office kept 82.8 per cent.

Total revenues generated by the use of air mail (letters, cards and parcel post) for both domestic and international service returned $176,000,000 to the Post Office while the airlines received $61,000,000 for carrying the mail.

In addition, last year, through a special arrangement with the Post Office Department, the airlines on a space available basis carried more than 4,300,000 first-class letters daily between certain cities along their domestic routes. And this "Three-Cent Air Mail Experiment," as it is called, in 1956, saved billions of hours in delivery time for millions of letter writers. Millions of letters reached their destinations an average of 12 hours sooner than had they traveled by surface means.

Started in 1953, the three-cent mail by air has proven highly successful. The total carriage of three-cent mail on a ton-mile basis was 15,013,000 ton-miles for fiscal 1956, or 19.8 per cent of total ton-miles of domestic mail flown by air. By the end of June 1956, after 33 months of the experiment, the airlines had received a total of $6,745,000 for carrying the three-cent letters between the points affected, less than .2 cents per letter carried. During the same period the service had generated a total of over $100,000,000 in revenue for the Post Office.

The experiment is a success, although the airlines are not certain they are being compensated enough for the service rendered.

At the same time, this does not mean that the regular six-cent air mail doesn't offer a superior service. It does. Regular air mail letters get special handling from the moment they are taken from the mail box. Furthermore, the six-cent air mail stamp is a guarantee that the letter goes by air, even at the expense of turning away passengers if the payload is too heavy. Air mail gets priority over all other types of cargo. The three-cent letter goes by air only when there is space available.

The airlines have also put wings on parcel post packages. Inaugurated on September 1, 1948, use of air parcel post has increased 277 per cent in seven years. The number of pieces flown, both domestic and international, in 1956, was 24,201,198, a gain of 11.9 per cent over the previous year.

NATIONAL DEFENSE

The airlines are constantly ready to augment airlift necessary to the nation's striking military air arm.

The planes, crews and maintenance support which the airlines contribute to the Civil Reserve Air Fleet (CRAF) program save hundreds of millions of dollars in tax monies which otherwise would have to be spent for maintaining emergency airlift on a stand-by basis

Contributing to the CRAF program—a joint military-airlines operation born of the lessons learned in World War II, the Berlin Airlift and Korea—the scheduled carriers, alone have 314 four engine airliners earmarked for CRAF.

The scheduled airlines made available an additional 24 of their biggest and best airliners to CRAF in 1956 The new planes represent a daily increase of more than 1,600,000 ton-mile airlift capacity, bringing the total CRAF capability up to 7,276,160 available ton-miles per ten-hour day.

The total equipment value of the scheduled airline share in CRAF is estimated at more than $400,000,000 To operate such a fleet on a stand-by basis would cost the government something like $300,000,000 a year.

In addition to their CRAF contribution, the scheduled airlines in 1956 stepped up their activities to provide more and better service to the military organizations using civil air transportation.

The scheduled airlines provided the military agencies with 922,728,874 passenger-miles of official travel in 1956 This is the equivalent of flying 37,000 troops around the world at the equator For the past seven and a half years the scheduled airlines have effectively served the military departments, in peace and emergency, through the Military Bureau of the Air Transport Association and its field offices

The scheduled airlines have established over 60 offices at military installations called JAMTO's (Joint Airline Military Traffic Office). These offices, under the jurisdiction of local military committees of the industry, assist in making arrangements for movement of both cargo and personnel

As an aftermath to the Hungarian Freedom uprisings, a JAMTO was established at reactivated Camp Kilmer This JAMTO worked around the clock to assist the welfare agencies handling refugees in the domestic transportation to relatives and sponsors

AIR NAVIGATION AND TRAFFIC CONTROL

Back in 1936, the scheduled airlines devised and put into practice the first system of air traffic control in this country. The operation was embryonic But it worked and it set the basic pattern for the traffic control system in use today The true significance, however, is the fact that almost 21 years ago the airlines themselves recognized the problem which today affects everyone who flies.

Today's vast and complicated Air Navigation and Traffic Control System is the direct responsibility of the Federal Government And the airlines have never held back in contributing to the further development of the system and its upkeep—both in know how and techniques, and in financial support.

The scheduled airline fleet of over 1,726 planes represents only about 1 6 per cent of the planes using the Federal Airways as they share the system with some 40,000 military planes and another 60,000 private and corporate aircraft

The nation's air traffic control system is the heart of our national defense air network Our bombers would not be able to strike, nor our fighters able to defend without it And these big users of the airways system must have priority for the nation's security Consequently, the system must be one which can integrate all segments of aviation—the private flyer, the business flyer, the commercial operator and the military—into a common system It costs many times more than any system which might be required by the airlines alone.

America's system of Air Navigation and Traffic Control is the finest, safest and most extensive network of aerial highways in the world The only thing wrong is that the system itself has been unable to keep pace with the tremendous increases in the number of planes that use it.

The problem is to allocate the required amount of airspace to all users, and then effectively control the traffic using it. The growth of aviation has outstripped our ability to control effectively our present volume of air traffic with the present air traffic control system.

The need is for immediate improvement of the present system to insure safe operation of today's aircraft—an interim system And beyond this, the need is for a whole new approach to the problem and the development of a completely new system that can handle the expected traffic increases and the bigger and faster planes that are coming.

Admittedly, no method of controlling air traffic exists today which will adequately serve tomorrow's planes, in tomorrow's numbers, flying at tomorrow's speeds.

The need for these improvements and a continuing effort to solve the air navigation and traffic control problem was clearly demonstrated on June 21, 1956 On that day, adverse weather conditions taxed the present system to its limits Over 31 per cent of all airline operations in the eastern half of the United States were cancelled or delayed And other elements of aviation, including the military, suffered accordingly It shouldn't have happened But it did And it is a striking example for the need of improving the situation.

RESOURCES

Although the scheduled airlines have demonstrated startling increases in providing more and better air service, their ability to earn profits for themselves has lagged far behind their capability to serve the public Airline profits are way out of balance when they are weighed against the progress the industry has accomplished Earnings are far below the margins of return of other public service industries. To bring the benefits of jet travel to the public, it is going to be increasingly difficult for the airline industry to pay off its indebtedness unless something is done to improve this earnings trend.

And this becomes even more evident when one considers the estimated net worth of the industry, set at $650,000,000 in 1956, and the $2,600,000,000 already committed for jetliners and other aircraft over the next five years.

Because the technological advances in aeronautical equipment have been so rapid, the airlines have been forced, time and again, into costly re-equipment programs.

For example if you take trunkline funds from all sources—earnings, sales of additional stock, borrowings, depreciation, property retirements and other amortizations—you come up, for the last ten years, with about $1,760,000,000 Some 82 per cent—$1 448,000,000—of that money was ploughed back into new and better equipment.

Security analysts tell us that a growth industry, such as scheduled air transport, ought to be paying out about 40 per cent of its net income, after taxes, in dividends The airlines, in the same ten year period, paid out about 32 per cent of net profits after taxes. The comparable figure for all U. S. corporations was 47 per cent of net profits after taxes.

The continuing need for a tremendous outlay of dollars for new equipment is pointed up by the increasing cost of the equipment itself.

In 1946 for example the largest four-engined airliner then available cost about $625,000 A similar airliner in 1956 was selling for $1,150,000 But, the bigger, faster, four-engined airliners last year cost about $2,000,000 each. The cost per plane of the biggest new jetliners on order will hit $6,250,000, which is fifty times the cost of the DC-3 airliner 20 years ago.

Operating expenses of the scheduled airlines amounted to $1,727,677,000 in 1956, an increase of 15.9 per cent over 1955 In spite of a 15.6 per cent increase in traffic gross profits of the industry were only $133,498,000 in 1956 or a decrease of 7.2 per cent from the previous year.

AVAILABLE SERVICE AND UTILIZATION

U. S. Scheduled Airline Industry, *1947-1956 (In Millions)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines										
Available Ton Miles Flown	1 209 7	1,357 9	1 517.4	1 684 1	1,974 1	2 399.3	2 893.3	3 314 1	3 882.7	4 392 8
Revenue Ton Miles Flown	689 1	706 2	809 0	963 2	1 204 7	1,413 5	1,644 3	1 857 6	2.190 6	2.452 5
Ton Mile Load Factor (%)	56 97	52.01	53 31	57 20	61 02	58 91	56 83	56 06	56 42	55 83
Available Seat Miles Flown	9 152.4	9 980 2	11 117 7	12 385 6	14 672	18 068 1	22 114 4	25 645 5	30 001 3	33.752 6
Revenue Passenger Miles Flown	6 016 3	5 822 4	6 570 7	7 766 0	10 210 8	12,120 8	14 297 6	16 246 3	19 217.2	21 643 1
Passenger Load Factor (%)	65 73	58 34	59 10	62 70	69 59	67 08	64 65	63 31	64.06	64 12
Revenue Plane Miles Flown	311 9	316.3	323.2	327.1	362 5	411 4	467 0	497.2	564 0	622.1
Local Service Airlines										
Available Ton Miles Flown	14 9	31.5	46 4	62 4	81.5	96.2	109 3	112 9	121 9	145 6
Revenue Ton Miles Flown	4 7	9 1	14 3	20 9	31.6	36 1	40.7	47 2	55.0	66 5
Ton Mile Load Factor (%)	31 87	28 92	30 93	33 51	38 79	37 53	37 28	41 77	45 14	45 70
Available Seat Miles Flown	155.5	323 9	477 9	599 2	774 7	905 4	1 013 6	1 069 7	1 161.4	1,385.1
Revenue Passenger Miles Flown	46 4	87 9	134 7	188 8	289.6	339.2	390 9	449.5	523 3	633 2
Passenger Load Factor (%)	29 85	27 14	28 18	31 51	37 39	37 46	38.56	42 02	45 06	45 72
Revenue Plane Miles Flown	10 1	18 0	24.5	33 0	38.0	41.1	45.6	47 7	50 9	59 8
Territorial Airlines										
Available Ton Miles Flown	8 3	9 1	10 1	10 9	13 8	14.2	15 9	15.7	16 1	16.0
Revenue Ton Miles Flown	4 9	5.2	5 3	5 8	6.6	7 0	7 4	7 7	8 8	8 8
Ton Mile Load Factor (%)	59 91	57.12	52 47	52 75	47 86	49 49	46 70	49.17	54 25	64 80
Available Seat Miles Flown	65 9	81 0	91 3	100 1	119 0	124 1	134 6	134 5	134 7	147 2
Revenue Passenger Miles Flown	46 8	52 9	52 6	57.7	65 8	67 9	71 8	72 7	78 1	83 9
Passenger Load Factor (%)	71 10	65 28	57 19	57.66	55.27	54 72	53.37	54 04	57 99	56.99
Revenue Plane Miles Flown	3.1	3.6	4.0	4.3	5.0	5.4	4 9	4.7	4.6	4.6
Helicopter Airlines *(in thousands)*										
Available Ton Miles Flown	14	108	142	189	185	181	360	388	434	574
Revenue Ton Miles Flown	3	28	46	63	71	75	129	152	192	281
Ton Mile Load Factor (%)	18 43	25 93	32 39	33 33	38 38	41.44	36 86	39 18	44 24	48 98
Revenue Passenger Miles Flown		—	—	—	—	—	191	716	1 708	3 387
Available Seat Miles Flown	—	—	—			—	26	183	628	1 583
Passenger Load Factor (%)	—	—	—	—	—	—	13.61	25 86	36.77	46.74
Revenue Planes Miles Flown	37	284	412	668	619	631	1,006	1,071	1,148	1,323
International and Overseas Airlines										
Available Ton Miles Flown	425 8	480 8	540 3	564.2	608 4	693 7	760 5	856 1	982.6	1,146.9
Revenue Ton Miles Flown	243 7	273 5	300 4	325 4	377 8	426 3	466 8	527.1	622 4	728 1
Ton Mile Load Factor (%)	57 24	56 89	55 60	58 17	62 09	61 45	61.38	61.57	63 34	63 48
Available Seat Miles Flown	2 924 3	3 292 3	3,624 7	3 695 5	4 361 4	4 848 8	5 462.2	6,284 9	7 012 1	8 073.2
Revenue Passenger Miles Flown	1 810 0	1 888 9	2,054 0	2,206 4	2 599 0	3 019 8	3,381 1	3 743 3	4 409 6	5 116.4
Passenger Load Factor (%)	61 90	57 37	56 67	59.71	59.59	62.28	61 90	59 56	62 89	63 38
Revenue Plane Miles Flown	86 5	98 1	104 5	93 8	97 4	103 4	109 6	116 1	130 7	146.0

AVAILABLE SERVICE AND UTILIZATION *(continued)*

U. S. Scheduled Airline Industry, *1947-1956 (In Millions)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Alaskan Airlines										
Available Ton Miles Flown		20 1	20.3	19 7	15 8	26 7	34 1	34.5	46 0	66.9
Revenue Ton Miles Flown		12.8	11 1	10 1	8 5	14 4	19 5	19 4	29 4	44 7
Ton Mile Load Factor (%)	Not	63 64	54 76	50 93	64 16	53 89	57 23	56 37	63 83	66.85
Available Seat Miles Flown	Available	42 6	38 9	64 0	82 4	168 8	209 2	206 3	233 9	284 1
Revenue Passenger Miles Flown		19 6	15 4	22 4	36 5	71 2	92 4	86.9	110 4	136 9
Passenger Load Factor (%)		46.10	39 64	41 60	44 26	42 18	44 15	42 15	47 20	48 20
Revenue Plane Miles Flown		4.6	3 9	5.4	6 9	9.3	10 4	9 6	10.5	11.3
All Cargo Airlines[1]										
Available Ton Miles Flown	—	—	16 5	80 2	126 2	118 6	121 8	108 8	184 5	284 5
Revenue Ton Miles Flown	—	—	11.6	59 5	103 6	97 0	97 3	88 6	136 0	216.8
Ton Mile Load Factor (%)	—	—	70 52	74 20	82 10	81 82	81 51	81 48	73 70	76 19
Available Seat Miles Flown	—	—	—	—	—	—	—	—	—	—
Revenue Passenger Miles Flown	—	—	—	—	—	—	—	—	—	—
Passenger Load Factor (%)	—	—	—	—	—	—	—	—	—	—
Revenue Plane Miles Flown	—	—	2.9	13 3	19 9	18 5	19 1	12.6	20 3	25.5
Total Scheduled Airline Industry										
Available Ton Miles Flown	1 658 7	1 899 5	2,151 1	2 411 6	2 819 9	3 348 9	3,935 3	4 442 5	5 234 2	6 053 3
Revenue Ton Miles Flown	942 4	1 006 8	1,151 8	1 364 9	1 732 8	1 994 3	2,278 2	2 547 8	3 042 4	3 517.7
Ton Mile Load Factor (%)	56 82	53 29	53 64	57 43	61 45	59 55	57 89	57 35	58.13	58.11
Available Seat Miles Flown	12 298 1	13 720 0	15 350 5	16 834 4	20 009 5	24 115 2	28 934.6	33 342 6	38 545 1	43 645 5
Revenue Passenger Miles Flown	7,919 5	7 871 7	8 827 4	10 241 3	13 201 6	16 618 9	18,233 8	20 598 9	24 339 2	27 615 1
Passenger Load Factor (%)	64 40	57 37	57 51	60 84	65 98	67 77	63.02	61 78	63 14	63 27
Revenue Plane Miles Flown	411 6	440 9	463 1	477 6	530 3	589 7	657 6	689 0	782 1	870 4

[1] Riddle and AAXICO data not included in 1956

REVENUE TON-MILE TRAFFIC CARRIED

by U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Revenue Ton-Miles)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines										
Passenger	579 859	558 680	632 014	747 558	982 642	1,167 556	1,377 728	1,568 413	1,856 196	2 091 517
Freight	35 214	70 438	94 190	112 861	100 581	117 128	131 778	144 276	174 023	190,597
U S Mail	32 879	37 510	40 874	46 315	62 932	68 296	71 725	80 201	86 034	91 686
Express	28 553	29 769	27 329	36 538	40 260	40 375	42 514	40 122	49 688	49 711
Charter Flights	5 774	3 188	7 483	8 203	8 576	8,593	6 874	8 317	5 730	5 884
All Other	6 875	6 657	7,102	11 782	9 680	11,512	13 706	16 288	19 049	23 060
Total	689 134	706,212	808 992	963 257	1,204 671	1,413 460	1 644 325	1,857 617	2 190 640	2,482 455

REVENUE TON-MILE TRAFFIC CARRIED *(continued)*

by U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Local Service Airlines										
Passenger	4 316	8 164	12 908	18 242	27 904	32 373	36 767	42 396	49,442	89 862
Freight	62	265	436	696	920	1,116	1,179	1 158	1,355	1 625
U S Mail	165	334	428	566	787	912	1,000	1 226	1 257	1 572
Express	118	190	320	623	908	894	964	1 043	1 403	1 688
Charter Flights	89	90	194	653	961	653	649	1,108	1 338	1,487
All Other	18	39	60	118	132	168	198	224	245	312
Total	4 738	9 102	14 346	20 898	31 612	36 116	40 747	47 155	55 040	66 546
Territorial Airlines										
Passenger	3 839	4 309	4 309	4 680	5 234	5 384	8 806	5 929	6 599	6 991
Freight	636	581	618	529	855	1,288	1,503	1 687	1,646	1,477
U S Mail	43	83	70	65	59	50	57	58	58	65
Express	116	134	124	119	100	55	—	—	—	
Charter Flights	184	39	123	304	283	272	27	45	436	235
All Other	68	68	66	56	50	49	46	34	20	19
Total	4,886	5 184	5 310	5 753	6 581	7 038	7,439	7 723	8 759	8 787
Helicopter Airlines										
Passenger	—	—	—	—	—	—	2	17	87	145
Freight	—	—	—	—	—	—	2	5	5	7
U. S Mail	3	28	46	63	71	75	123	118	96	92
Express	—	—	—	—	—	—	—	13	31	36
All Other	—	—	—	—	—	—	2	2	3	1
Total	3	28	46	63	71	75	129	152	192	281
International and Overseas Airlines										
Passenger	184 303	194 399	211 734	228 114	266 989	310 716	345 383	379 787	442 808	511 673
Freight	2 110	4 012	6 714	16 050	71,004	72 346	74 427	81 886	89 598	109 227
U S Mail	12 756	17 203	19,772	21 188	21 875	22 068	24 466	35 323	82 409	55 158
Express	30 786	41 581	49 444	44 513	289	281	219	217	243	
Charter Flights	5 275	7 990	3 233	5 730	6 724	7 546	7 700	13,790	19 701	32 370
All Other	8 483	8 314	9 515	9 825	10 903	13 051	14 583	16 136	17 647	19 690
Total	243 713	273 499	300 412	328 420	377 784	426 308	466 778	527 139	622 406	728 118
Alaskan Airlines										
Passenger	—	1,962	1 543	2 245	3,743	7 490	9 838	9 139	11,752	14 617
Freight	—	1,027	618	882	1,763	4 282	5,908	5 998	7 300	7 985
U S Mail	—	281	479	741	970	1 891	1 987	2,058	2 379	2 381
Charter Flights	—	9 509	8 449	6 098	2,016	955	1 640	2,086	7,773	19 532
All Other	—	40	27	90	51	99	114	114	149	243
Total	—	12 819	11,116	10,053	8 543	14 387	19 487	19 395	29 353	44 728

REVENUE TON-MILE TRAFFIC CARRIED *(continued)*

by U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Revenue Ton-Miles)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
All Cargo Airlines[1]										
Passenger	—	—	—	—	—	—	—	—	—	—
Freight	—	—	10 842	58 420	78,578	92 367	88,812	76 653	108 920	123,368
U S Mail	—	—	—	—	—	—	—	—	322	1 147
Express	—	—	—	—	—	—	—	—	—	843
Charter Flights	—	—	1,124	1,128	28 038	4 670	10 817	11,988	26 758	91,415
Excess Baggage	—	—	—							—
Total	—	—	11 666	59 545	103 616	97 037	99 329	88 641	136 000	216 773
Total Scheduled Airlines Industry										
Passenger	772 317	767 534	862 508	1 000 839	1 286 512	1 523 489	1,775 524	2 005 681	2 366 854	2 684 805
Freight	38 022	76 323	113 118	189 438	253 701	288 467	303 609	311 633	382 847	434 256
U S Mail	45 846	55 409	61 669	68 938	86 694	92 992	99 358	118 981	142 555	152 098
Express	59 553	71,674	77 217	81 793	41 557	41 605	43 687	41 395	51 285	52 278
Charter Flights	11 292	20,786	20 606	22 110	43,598	22 989	27 407	37 334	61 736	150 923
All Other	15 444	15 118	16 770	21 871	20 816	24 879	28 649	32 798	37 113	43 325
Total	942 474	1 006 844	1 151 888	1 384 989	1 732 878	1 994 421	2 278 234	2 547 822	3 042 390	3 517 685

[1] Riddle and AAXICO data not included in 1956.

OPERATING REVENUES

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines										
Passenger	$ 303 194	334 736	378 113	430 098	570 288	671 287	778 782	872 834	1,021 853	1 142 124
Freight	$ 8 358	13 825	18 323	21 698	21 030	25 529	29 341	33 009	39 605	42,166
U S Mail	$ 23 326	47 838	45 031	46 311	37 040	35 910	37 083	37 318	30 130	34 202
Express	$ 10 530	9,964	8 957	12 569	14 706	15 853	16 829	15 107	19 405	18 057
Other	$ 7 082	6 990	9 359	13 433	15 457	19 466	19 758	19 953	22 355	26 203
Total	$ 352 490	413 353	459 783	524 109	658 521	768 015	878 793	978 218	1 133 348	1 262 758
Local Service Airlines										
Passenger	$ 2 280	4 667	7 362	10 303	16 259	19 766	23 306	27,673	32 840	40 139
Freight	$ 17	76	138	212	309	405	462	502	556	746
U. S. Mail	$ 5 920	10 911	13 533	16 581	18 850	21 177	24 356	24 893	21 896	24 050
Express	$ 43	72	114	230	357	417	463	496	665	774
Other	$ 151	195	271	544	966	614	771	1 151	1 279	1 671
Total	$ 8,411	15 921	21 418	27 870	36 741	42 379	49 388	54 718	57,236	67 380

[1] Preliminary data

OPERATING REVENUES (continued)

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Territorial Airlines											
Passenger	$	3 102	3 888	3 799	4 105	4 639	4 433	4 771	8 270	8 685	6,042
Freight	$	321	302	333	288	393	562	692	732	752	782
U. S. Mail	$	162	189	247	285	643	768	1,128	640	338	341
Express	$	108	134	145	125	119	63				
Other	$	208	137	254	410	418	420	135	148	338	265
Total	$	3 901	4 650	4 778	5 213	6 212	6,246	6 726	6 790	7 114	7,430
Helicopter Airlines											
Passenger	$	—	—	—	—	—	—	10	63	205	440
Freight	$	—		—	—	—	—	4	16	21	29
U. S. Mail	$	37	372	522	791	887	1,033	2,547	2,878	2,948	2,776
Express	$	—	—		—	—			38	95	114
Other	$				7	5	13	44	78	82	63
Total	$	37	372	522	798	892	1,046	2 605	3 070	3,351	3 422
International and Overseas Airlines											
Passenger	$	140 652	151 338	158 480	160 673	184 592	212 458	232 539	254 234	294 824	347 613
Freight	$	689	1 370	2 105	5 881	25 116	26 730	27 257	29 614	31 854	36 774
U. S. Mail	$	32 300	57 332	75 197	55 689	53 213	81 553	83 746	49,192	27 223	35 306
Express	$	16,837	19 438	20 023	15 783	94	87	74	70	77	—
Other	$	18 532	19,756	18 350	22 105	24 784	24 110	23 670	25 739	30 324	38 064
Total	$	209 010	249,234	274 155	260 131	287 799	314 918	337 286	358 849	384 302	452 757
Alaskan Airlines											
Passenger	$	—	2 492	2 188	2 758	4 042	5 857	6 815	6 479	8 162	10 188
Freight	$		529	547	639	928	1 474	1 851	1 837	2 464	2 761
U. S. Mail	$	—	1 530	2 122	2 939	3 742	7,824	9,060	9 226	7 954	8 719
Other	$		3 798	3 639	3,102	3,430	1 106	1,574	1,662	3 747	7,671
Total	$		8 349	8 496	9,438	12 142	15 961	19,300	19 204	22,324	29 339
All Cargo Airlines[2]											
Passenger	$	—	—	—	—	—	—	—	—	—	—
Freight	$	—	—	1 810	8 850	12 017	14,498	14 825	13 958	18 634	23 586
U. S. Mail	$	—	—							57	497
Other	$	—	—	300	3 511	8 348	2 549	4 391	3 001	8 336	14 008
Total	$	—	—	2 110	12 361	17 365	17 047	19 216	16 959	27 027	38 090

[1] Preliminary data
[2] Seaboard and Western data not included in 1956

OPERATING REVENUES (continued)

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Total Scheduled Airline Industry											
Passenger	$	449 228	497,121	549 942	607 937	779,820	913 771	1 043 223	1,166 553	1,363 569	1,541 545
Freight	$	9 385	16 102	23 256	37 568	59 793	69 198	74 432	79 668	93 896	106 843
U. S. Mail	$	61 745	118 172	136 652	122 596	114 375	117 945	127 920	124 144	91 869	195 891
Express	$	27 518	29 608	29 239	28 707	15 276	16 420	17 366	15 708	20 246	18 945
Other	$	28 973	30 876	32,173	43 112	50 408	48 278	50 343	51 732	65 137	87 951
Total	$	573 849	691 879	551 262	839 920	1 019,672	1,165 612	1 313 254	1 437 805	1,634 707	1,861 178

[1] Preliminary data

DISTRIBUTION OF AIRCRAFT OPERATING EXPENSES

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Domestic Trunk Airlines										
Flying Operations	$ 85 933	104 164	119 961	132 060	160 469	193 384	234 928	260 234	302 526	340 720
% of Total Expenses	23.0	25.3	27.6	28.6	29.0	28.7	29.7	29.6	30.0	29.3
Direct Maint—Flight Equip	$ 41 029	46 093	50 270	53 747	66 571	86 452	94 816	103 104	127 418	156 549
% of Total Expenses	11.0	11.2	11.6	11.6	12.0	12.8	12.0	11.7	12.6	13.5
Depreciation—Flight Equip	$ 36 241	39 834	39 448	39 430	41 273	57 735	79 305	94,344	90,226	93 547
% of Total Expenses	9.7	9.6	9.1	8.5	7.5	8.6	10.0	10.7	8.9	8.0
Total Aircraft Oper Expenses	$163 203	189 791	209 679	225 237	268 313	337 571	409 049	457 682	820 170	590 816
Local Service Airlines										
Flying Operations	$ 2 190	4 433	6 336	8 330	10 944	13 394	15 748	17 246	18 070	21 556
% of Total Expenses	24.3	28.5	29.0	30.8	30.5	30.8	30.9	32.5	31.8	31.6
Direct Maint—Flight Equip	$ 1 332	2 289	3 198	3 433	4 284	5 451	6 479	8 950	6 709	8 235
% of Total Expenses	14.8	14.7	14.6	12.7	11.9	12.5	12.7	11.2	11.8	12.1
Depreciation—Flight Equip	$ 908	1,378	1 938	1 492	1 613	2 098	2,443	1 893	1,818	2,148
% of Total Expenses	10.1	8.8	8.4	5.5	4.5	4.8	4.8	3.6	3.2	3.2
Total Aircraft Oper Expenses	$ 4 430	8 097	11 472	13 255	16 841	20,943	24,670	28,089	26 897	31,939
Territorial Airlines										
Flying Operations	$ 704	946	1,091	1,221	1 468	1 623	1 875	1 908	1,942	2 032
% of Total Expenses	18.8	21.3	22.6	23.1	24.2	27.2	27.7	27.0	26.5	27.8
Direct Maint—Flight Equip	$ 537	603	851	543	644	580	635	713	715	716
% of Total Expenses	14.4	13.6	11.4	10.3	10.6	9.7	9.2	10.1	9.8	9.8
Depreciation—Flight Equip	$ 259	330	331	359	253	143	392	482	488	320
% of Total Expenses	6.9	7.4	6.9	6.8	4.2	2.4	5.8	6.8	6.7	4.4
Total Aircraft Oper Expenses	$ 1 500	1,879	1,973	2 123	2,365	2,346	2 892	3,103	3 145	3 068

[1] Preliminary data

DISTRIBUTION OF AIRCRAFT OPERATING EXPENSES *(continued)*

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Helicopter Airlines										
Flying Operations	$ 13	94	151	205	135	264	540	583	613	707
% of Total Expenses	25.0	27.2	29.6	28.0	18.7	25.1	22.8	22.1	20.7	19.1
Direct Maint—Flight Equip	$ 5	50	83	116	182	213	418	533	566	626
% of Total Expenses	9.6	14.5	16.3	16.0	25.2	20.3	20.3	20.2	19.2	16.9
Depreciation—Flight Equip	$ 14	81	105	123	76	128	456	391	405	549
% of Total Expenses	26.9	23.4	20.6	16.8	10.5	12.2	19.3	14.8	13.7	14.8
Total Aircraft Oper Expenses	$ 32	225	339	444	393	505	1,477	1 507	1 584	1 882
International and Overseas Airlines										
Flying Operations	$ 53 189	67 163	72 347	70 980	75 031	87 368	91 489	98 755	108 553	125 646
% of Total Expenses	25.4	28.5	28.6	28.6	27.8	28.7	28.8	29.7	29.7	29.9
Direct Maint—Flight Equip	$ 21 997	24 241	26 311	26 158	29 856	33 043	32 808	30 811	34 632	44 696
% of Total Expenses	10.5	10.3	10.4	10.5	11.1	10.9	10.3	9.3	9.5	10.7
Depreciation—Flight Equip	$ 18 580	19 589	23,676	25 638	24 263	26 480	26 723	27 799	27,547	30 942
% of Total Expenses	8.9	8.3	9.4	10.3	9.0	8.7	8.4	8.4	7.5	7.4
Total Aircraft Oper Expenses	$ 93 766	110 993	122 334	122,776	129 150	146 891	151 020	157 365	170 732	201 164
Alaskan Airlines										
Flying Operations	$ —	3 138	3 440	3 020	4 180	4 634	5 479	5 224	7 232	9 899
% of Total Expenses	—	38.9	33.8	31.1	31.6	28.4	30.0	28.9	33.8	36.4
Direct Maint—Flight Equip	$ —	923	1 342	1 591	2 257	2 744	2 673	2 580	3 083	3 610
% of Total Expenses		11.4	13.2	16.4	17.2	16.8	14.7	14.3	15.0	13.3
Depreciation—Flight Equip	$ —	810	987	880	718	741	863	1,087	899	1 008
% of Total Expenses	—	10.0	9.7	9.1	5.5	4.5	4.7	6.0	4.1	3.7
Total Aircraft Oper Expenses	$	4 871	5 769	5 491	7 138	8 119	9 015	8 891	11 214	14 517
All Cargo Airlines[2]										
Flying Operations	$ —		966	4 633	6 361	6 752	8 062	7 834	10 632	15 997
% of Total Expenses	—	—	42.3	42.9	44.4	42.4	42.2	39.6	40.4	40.2
Direct Maint—Flight Equip	$ —	—	270	1,332	1 823	2 808	3 121	2 668	3 782	8 972
% of Total Expenses	—	—	11.8	12.3	12.7	17.6	16.3	13.5	14.4	15.0
Depreciation—Flight Equip	$ —	—	54	246	356	495	836	1 930	1 834	2,793
% of Total Expenses		—	2.4	2.3	2.8	3.1	4.4	9.8	7.0	7.0
Total Aircraft Oper Expenses	$ —	—	1 290	6,211	8 540	10 055	12 019	12,432	16 248	24 762
Total Scheduled Airline Industry										
Flying Operations	$142 029	179 938	204 292	220 449	258 568	307 419	358 121	391 784	449 568	516 457
% of Total Expenses	23.9	26.7	28.1	28.9	29.0	29.0	29.7	29.9	30.2	29.9
Direct Maint—Flight Equip	$ 64 900	74 199	82 025	86 920	105 617	131 291	141 003	146 359	176 905	220,404
% of Total Expenses	10.9	11.0	11.3	11.4	11.8	12.4	11.7	11.2	11.9	12.8
Depreciation—Flight Equip	$ 56 002	61 719	66 539	68 168	68 552	87 820	111 018	127,926	123 217	131,307
% of Total Expenses	9.4	9.1	9.1	8.9	7.7	8.3	9.2	9.7	8.3	7.6
Total Aircraft Oper Expenses	$262 931	315 856	352 856	375 537	432 737	526 530	610 142	666 089	749 690	868 168

[1] Preliminary data.
[2] Seaboard and Western data not included in 1956.

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Domestic Trunk Airlines										
Ground Operations	$ 59 464	64 915	66 623	68 541	79 265	94 606	107 044	119 207	133 231	152 884
Ground and Indirect Maintenance	$ 32 812	33 515	33 404	33 653	41 110	50 856	56 940	61 331	68 736	82 760
Passenger Service	$ 28 669	29 151	27 778	30 870	42 563	47 045	53 115	58 235	72 978	83 938
Traffic and Sales	$ 42 644	42 668	45 661	48 079	58 024	70 253	81 472	89 288	103 882	124 507
Advertising and Publicity	$ 9 486	12 343	13 533	14 566	16 211	18 880	22 027	24 861	30 809	34 807
General and Administrative	$ 31 052	31 217	30 894	33 651	40 816	46 874	52 259	57 744	68 827	79 646
Depreciation—Ground Equipment	$ 6 060	7 678	7 585	6 941	6 279	6,807	8 515	10 411	11 430	12 737
Total—Ground and Indirect Expenses	$210,187	221,487	225 478	236 301	264 268	335 321	381 372	421,077	489 893	571 279
Local Service Airlines										
Ground Operations	$ 1 650	2 682	3 743	4 969	6 229	7 254	8 406	8,753	9 511	11,168
Ground and Indirect Maintenance	$ 740	1 114	1 339	1 823	2 496	3,150	3 596	3,666	3 756	4 328
Passenger Service	$ 261	540	825	1 090	1 671	1 944	2 218	2 389	2 684	3 383
Traffic and Sales	$ 660	1 053	1 771	2 434	3 943	4 868	6 099	6 895	7 618	9 465
Advertising and Publicity	$ 251	386	634	807	1 072	1,172	1,340	1,449	1 656	1 918
General and Administrative	$ 902	1 436	1 792	2 484	3 301	3 682	4 028	4 330	4,463	5 358
Depreciation—Ground Equipment	$ 123	270	298	344	440	464	546	535	554	629
Total—Ground and Indirect Expenses	$ 4 587	7,481	10 399	13 951	19 152	22 554	26 233	28 017	30 242	36 249
Territorial Airlines										
Ground Operations	$ 767	904	922	906	1 040	1,001	1 212	1,269	1 258	1 317
Ground and Indirect Maintenance	$ 342	357	349	399	433	384	482	532	562	541
Passenger Service	$ 97	140	166	190	223	213	210	198	245	252
Traffic and Sales	$ 388	441	528	681	858	881	768	769	842	958
Advertising and Publicity	$ 50	42	100	151	172	167	143	140	204	226
General and Administrative	$ 502	567	682	743	887	899	953	955	963	847
Depreciation—Ground Equipment	$ 96	103	113	93	89	81	97	114	116	97
Total—Ground and Indirect Expenses	$ 2 239	2 564	2 859	3 163	3 702	3 626	3 865	3 977	4,190	4,238
Helicopter Airlines										
Ground Operations	$ 3	33	80	98	108	138	283	334	425	543
Ground and Indirect Maintenance	$ 6	39	50	66	89	124	217	275	305	360
Passenger Service	$ —	—		—	—	—	11	15	22	22
Traffic and Sales	$ —				—		26	75	141	269
Advertising and Publicity	$ —	2	2	2	1	3	17	32	40	43
General and Administrative	$ 9	43	63	112	119	164	306	365	393	499
Depreciation—Ground Equipment	$ 2	4	6	10	11	16	30	35	45	84
Total—Ground and Indirect Expenses	$ 20	121	171	288	328	445	890	1,131	1,371	1 820
International and Overseas Airlines										
Ground Operations	$ 30 460	31 005	33 168	31 618	34 916	39 726	42 189	43 397	47 050	51,468
Ground and Indirect Maintenance	$ 17 805	20 219	20 934	17 282	20 014	21 188	22 219	22 302	24 236	27,354
Passenger Service	$ 13 084	14 034	14,617	14 589	17 511	19 554	20 027	22 372	26 716	31,050
Traffic and Sales	$ 21 996	25 380	25 560	25 886	29 821	34 945	37,727	40 573	45 872	53 163
Advertising and Publicity	$ 6 748	7 861	10 171	10 628	11 374	12 541	13,692	14 273	16,095	17,679
General and Administrative	$ 22 722	22,887	22 600	22 170	23 903	26 754	27 931	28 970	31 377	33 824
Depreciation—Ground Equipment	$ 2 716	2 938	3 479	3 374	3 041	2 668	3 102	3 434	3 526	3 896
Total—Ground and Indirect Expenses	$118 828	124 294	130 529	125 547	140 580	157 376	166 887	178 321	194 872	218 234

[1] Preliminary data

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES (continued)

U. S. Scheduled Airlines, *1947 1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Alaskan Airlines											
Ground Operations	$	—	845	988	966	1,411	2,182	2 449	2 612	4 224	5 389
Ground and Indirect Maintenance	$		525	1 001	774	1 429	1 923	1,919	1,997	2 010	2,256
Passenger Service	$		268	370	358	501	694	797	696	771	962
Traffic & Sales	$		435	598	499	699	1,170	1 364	1 384	1,321	1 514
Advertising and Publicity	$		102	116	136	175	209	297	265	275	321
General and Administrative	$		903	1 180	1 332	1 591	1 767	2 100	1 932	1 582	1 872
Depreciation—Ground Equip	$		121	156	148	204	264	302	308	310	359
Total—Ground & Indirect Expenses	$		3 199	4 409	4 212	6,010	8 209	9 228	9,214	10 493	12,673
All Cargo Airlines[1]											
Ground Operations	$			206	1 033	992	2 383	2 644	2 812	3 895	6 228
Ground and Indirect Maintenance	$			97	437	747	875	800	1 138	1 503	2 335
Passenger Service	$					1		23	209	269	610
Traffic and Sales	$			445	1 939	2 886	1 004	1 233	945	1 788	2 565
Advertising and Publicity	$		—	8	40	107	309	249	70	288	428
General and Administrative	$			215	1 047	1,007	1,182	1 760	1 969	2 103	2 490
Depreciation—Ground Equip	$			20	83	71	109	163	198	239	340
Total—Ground & Indirect Expenses	$			991	4 579	5 801	5 862	7 072	7 341	10 085	15 016
Total Scheduled Airline Industry											
Ground Operations	$	92 344	100 384	105 700	108 131	123 951	147 290	164 427	178 384	199 594	228 997
Ground and Indirect Maintenance	$	51 705	55 769	87 174	84 434	66,318	78 500	86 173	91 241	101 108	119 934
Passenger Service	$	42 111	44 133	43 755	47 097	62 470	69 450	76 401	84 114	103 685	120 237
Traffic and Sales	$	65 685	69 947	74 563	79 818	96 231	113 121	128 689	139 929	161,464	192 441
Advertising and Publicity	$	16 532	20 736	24 564	26 329	29,112	33 281	37 768	41 090	49 367	55 422
General and Administrative	$	56 187	57 053	57 426	61 539	71 624	81 322	89 337	96 284	109 708	124 536
Depreciation—Ground Equip	$	8 997	11 114	11 654	10 993	10 135	10 429	12 755	15 035	16 220	17 942
Total—Ground & Indirect Expenses	$	332 561	359 136	374 836	388 041	489 841	533 393	595 547	646 077	741 146	859 509

[1] Seaboard and Western data not included in 1956.

SUMMARY OF PROFIT OR LOSS

U. S. Scheduled Airlines, *1947 1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
Domestic Trunk Airlines											
Total Operating Revenues	$	352 490	413 353	459 783	524 109	658 521	768 015	878,793	978 218	1,133 348	1 262 758
Total Operating Expenses	$	373 390	411 278	435 157	461 538	562 581	672 892	790 421	878 759	1 010 063	1 162 095
Net Operating Income	$	(20 900)	2,075	24 626	62 571	105 940	95 123	88 372	99 458	123 285	100 663
Net Income Before Income Taxes[1]	$	(26 258)	(1 413)	20 663	55 305	103 355	102 814	96 008	102 161	133 075	114,832
Income Taxes	$	(6 016)	3 583	7 285	28 426	59 858	49 280	47 624	50 671	70 082	57 408
Net Profit or Loss	$	(20 242)	(4 996)	13 378	30 879	43 497	53 534	48 384	51 490	63 013	57 424

[1] Net income before taxes is adjusted for nonoperating items.
( ) Denotes red figures.
[2] Preliminary data.

SUMMARY OF PROFIT OR LOSS (continued)

U. S. Scheduled Airlines, *1947 1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
Local Service Airlines											
Total Operating Revenues	$	8 411	16 921	21 418	27 683	36 741	42 379	49 358	54 473	57 236	67 380
Total Operating Expenses	$	9 017	15 578	21 871	27 206	35 993	43 497	50 903	53 105	56 839	68 188
Net Operating Income	$	(606)	343	(453)	477	802	(1 118)	(1 545)	1 368	397	(808)
Net Income Before Income Taxes[1]	$	(1 182)	(486)	(1 283)	(176)	601	(345)	(2 080)	1 212	637	(962)
Income Taxes	$	(77)	94	168	399	399	141	(47)	254	481	39
Net Profit or Loss	$	(1 105)	(580)	(1,451)	(575)	202	(486)	(2 033)	958	157	(923)
Territorial Airlines											
Total Operating Revenues	$	3 901	4 650	4 778	5 213	6 212	6 246	6 726	6 788	7 114	7 430
Total Operating Expenses	$	3 739	4 433	4 832	5 286	6 067	5 972	6 757	7 080	7,335	7,306
Net Operating Income	$	162	217	(54)	(73)	145	274	(31)	(292)	(221)	124
Net Income Before Income Taxes[1]	$	124	167	(132)	(135)	125	254	(10)	(454)	(117)	14
Income Taxes	$	35	65	57	3	77	88	(51)	(27)	8	—
Net Profit or Loss	$	89	102	(189)	(138)	48	166	41	(427)	(125)	14
Helicopter Airlines											
Total Operating Revenues	$	37	372	522	798	892	1 046	2 605	3 069	3 351	3 422
Total Operating Expenses	$	52	346	510	732	721	1 050	2 367	2,638	2 955	3 702
Net Operating Income	$	(15)	26	12	66	171	(4)	238	431	396	(280)
Net Income Before Income Taxes[1]	$	(22)	(4)	(16)	36	138	(50)	169	353	543	(345)
Income Taxes	$		—		8	42	30	68	163	201	(1)
Net Profit or Loss	$	(22)	(4)	(16)	28	96	(80)	100	190	342	(344)
International & Overseas Airlines											
Total Operating Revenues	$	209 010	249 234	274 155	260 131	287 799	314 918	337 286	358 856	384 302	452 757
Total Operating Expenses	$	209 294	235 287	252 863	248 323	269 730	304 267	317 907	322 686	365 604	419 418
Net Operating Income	$	(284)	13,947	21 292	11 808	18 069	10 651	19 379	26 170	18 698	33 339
Net Income Before Income Taxes	$	(4 473)	8 780	8 816	13 631	18 801	14 380	23 393	29 723	23 581	38 188
Income Taxes	$	651	2 415	1,362	3 623	7 063	6 651	10 865	13 047	10 358	17 847
Net Profit or Loss	$	(5 124)	6 365	7 454	10 008	11 738	7 729	12 528	16 676	13 226	20 311
Alaskan Airlines											
Total operating Revenues	$	—	8 349	8 496	9 438	12 142	15,961	19 300	19 206	22 329	29 339
Total Operating Expenses	$		8 070	10 178	9 703	13 145	16 328	18 243	18 105	21,707	27 190
Net Operating Income	$	—	279	(1 682)	(265)	(1 003)	(367)	1,057	1,099	617	2,149
Net Income Before Income Taxes[1]	$	—	171	(1 817)	(396)	(1,196)	(78)	873	1 126	828	1 957
Income Taxes	$	—	26	15	37	24	373	113	232	259	896
Net Profit or Loss	$	—	145	(1,832)	(433)	(1 220)	(481)	760	894	569	1,061

[1] Net income before taxes is adjusted for nonoperating items.
( ) Denotes red figures.
[2] Preliminary data.

SUMMARY OF PROFIT OR LOSS *(continued)*

U. S. Scheduled Airlines, *1947-1956 (in thousands of dollars)*

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[2]
All Cargo Airlines[3]											
Total Operating Revenues	$			2 110	12 361	17 365	17 047	19 216	16 959	27 027	38 090
Total Operating Expenses	$			2 281	10 790	14 341	15 917	19 091	19 773	26 333	39 778
Net Operating Income	$			(171)	1 571	3 024	1,130	125	(2 814)	694	(1 688)
Net Income Before Income Taxes[1]	$			(153)	1 779	3 735	2,399	3 626	(3 404)	1 260	2 189
Income Taxes	$			2	875	2 050	709	1 357	(1 624)	20	951
Net Profit or Loss	$			(155)	1 204	1 685	1 690	2 269	(1 780)	1 240	1 238
Total Scheduled Airline Industry											
Total Operating Revenues	$	573 849	697 879	771 262	839 920	1 019 672	1 165 612	1 313 284	1 437 805	1 634 707	1 861 175
Total Operating Expenses	$	595 492	674 992	727 692	763 578	892 578	1 059 923	1 205 689	1 312 146	1 490 836	1 727 677
Net Operating Income	$	(21 643)	16 887	43 570	76 342	127 094	105 689	107 595	125 659	143 877	133 498
Net Income Before Income Taxes[1]	$	(31 811)	7,215	26 078	74 044	125 559	119 374	121 978	130 717	159 807	155 842
Income Taxes	$	(5 407)	6 183	8 889	33 071	69 513	57 272	59 929	62,716	81,385	77 062
Net Profit or Loss	$	(26 404)	1,032	17 189	40 973	56 046	62 102	62 049	68 001	78,422	78 780

[1] Net income before taxes is adjusted for nonoperating items
( ) Denotes red figures
[2] Preliminary data
[3] Seaboard and Western data not included in 1956

ASSETS, LIABILITIES AND CAPITAL

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
Domestic Trunk Airlines					
Assets					
Current Assets	$171 860	203 952	344 115	358 375	406 956
Flight Equipment	$299 261	374 803	567 787	782 816	1 026 730
— Depreciation	$110 910	173 183	258 431	394 292	533 100
Flight Equipment—Net	$188 351	201 620	309 356	388 524	493 630
Ground Property and Equipment—Net	$ 73 722	59 265	76 506	90 371	121 972
Property and Equipment—Net	$262 073	260 885	385 862	478 895	615 602
Deferred Charges	$ 16 497	16 361	8,194	9,211	12 302
Other Assets	$ 33 811	61 341	37 593	38 035	126 493
Total Assets	$484 241	842 539	775 764	884 816	1 161 363
Liabilities and Capital					
Current Liabilities	$ 99 837	130 107	231 760	241 942	292,112
Long Term Debt	$167 404	135 842	168 247	185 093	262 956
Operating Reserves	$ 2 387	3 971	4,169	5 796	10 760
Capital Stock	$121 313	123 469	145,135	139 360	108 300
Capital Surplus	$ 60 573	64 644	89 028	91 845	165 144
Earned Surplus	$ 13 943	67 179	133 532	207 947	290 374
Other Liabilities	$ 18 784	17 327	3 893	12 533	31 707
Total Liabilities and Capital	$484 241	542 539	775 764	864 516	1,161 353

[1] Data for 1956 are as of Sept 30th

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
Local Service Airlines					
Assets					
Current Assets	$ 5 279	7 577	10 359	11 927	13 769
Flight Equipment	$ 5 671	10 056	16 404	17 693	28 806
— Depreciation	$ 2 396	5 020	6 788	9 873	12 384
Flight Equipment—Net	$ 3 275	5 036	9 616	7 820	13 422
Ground Property and Equipment—Net	$ 2 016	1 882	3 722	2 735	4 844
Property and Equipment—Net	$ 5 291	6 918	13 338	10 555	18 266
Deferred Charges	$ 1 349	1 743	1 209	1 018	1 161
Other Assets	$ 819	821	917	573	1 407
Total Assets	$ 12 738	16 759	25 823	24 073	34 603
Liabilities and Capital					
Current Liabilities	$ 3 333	6 542	10 346	10 666	16 446
Long Term Debt	$ 1 590	1 485	3,575	1 931	6 060
Operating Reserves	$ 105	287	357	616	1 119
Capital Stock	$ 4 832	6 938	7 218	6 720	6 799
Capital Surplus	$ 4 454	4 193	5 633	4 654	4 912
Earned Surplus	$ (1 665)	(2 815)	(1 821)	(556)	(889)
Other Liabilities	$ 89	129	515	42	156
Total Liabilities and Capital	$ 12 738	16 789	25 823	24 073	34 603
Territorial Airlines					
Assets					
Current Assets	$ 1 333	1 649	1 900	1 577	1 246
Flight Equipment	$ 2 411	2 300	4 338	6 354	5 994
— Depreciation	$ 1 261	1 653	2 277	2 899	3 046
Flight Equipment—Net	$ 1 150	647	2 061	3 455	2 948
Ground Property and Equipment—Net	$ 530	487	887	630	457
Property and Equipment—Net	$ 1.680	1.134	2 948	4 085	3 405
Deferred Charges	$ 85	72	268	161	151
Other Assets	$ 65	227	526	9	14
Total Assets	$ 3.163	3 082	5 642	5 832	4 816
Liabilities and Capital					
Current Liabilities	$ 486	466	1 601	1 751	1 444
Long Term Debt	$ 4		1,222	1,725	1 741
Operating Reserves	$ 62	47	79	84	54
Capital Stock	$ 1.845	1 848	2 775	2 776	1 981
Capital Surplus	$ 372	372	372	386	832
Earned Surplus	$ 305	278	(419)	(898)	(1 237)
Other Liabilities	$ 89	74	12	5	1
Total Liabilities and Capital	$ 3 163	3 082	5 642	5 832	4 816
Helicopter Airlines					
Assets					
Current Assets	$ 63	302	900	2,659	1,757
Flight Equipment	$ 297	528	1 371	2 285	3 845
— Depreciation	$ 94	285	385	1 176	1,646
Flight Equipment—Net	$ 203	243	986	1 109	2 199
Ground Property and Equipment—Net	$ 10	32	105	158	315
Property and Equipment—Net	$ 213	275	1 091	1 267	2 514
Deferred Charges	$ 89	71	263	145	169
Other Assets	$ 1	84	113	42	378
Total Assets	$ 366	732	2 367	4,113	4,818
Liabilities and Capital					
Current Liabilities	$ 97	69	430	686	481
Long Term Debt	$		138	204	711
Operating Reserves	$		4	33	50
Capital Stock	$ 294	695	816	899	677
Capital Surplus	$		974	1 998	2 201
Earned Surplus	$ (28)	(32)	5	309	698
Other Liabilities	$			14	
Total Liabilities and Capital	$ 366	732	2 367	4 113	4 818

[1] Data for 1956 are as of Sept. 30th
( ) Denotes red figures

April 22, 1957

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956[1]
International and Overseas Airlines					
Assets					
Current Assets	$ 71 748	93 957	79 437	97 695	108 420
Flight Equipment	$ 94 782	133 489	164 524	193 798	256 410
— Depreciation	$ 32 398	55 495	76 243	91 061	110 371
Flight Equipment—Net	$ 62 384	77 994	88 281	102 737	146 039
Ground Property and Equipment—Net	$ 15 030	12 231	12 775	13 380	15 941
Property and Equipment—Net	$ 77 414	90 225	101 056	116 177	161 980
Deferred Charges	$ 24 909	25 688	20 706	4,685	4 541
Other Assets	$ 30 403	9 190	16 554	21 273	38 746
Total Assets	$204 474	219 070	217 753	241 770	313 687
Liabilities and Capital					
Current Liabilities	$ 31 477	52 623	66 986	81 341	92 356
Long Term Debt	$ 5 800	41 250	27 955	29 575	72 379
Operating Reserves	$ 5 438	5 776	6 314	3 637	4 136
Capital Stock	$ 7 665	10 766	10 895	13 068	13 777
Capital Surplus	$ 30 518	62 828	62 828	62 880	63 338
Earned Surplus	$ 18 691	26 024	33 584	47 184	60 690
Other Liabilities	$104 885	19 803	9 191	4 085	7 011
Total Liabilities and Capital	$204 474	219 070	217 753	241 770	313 687
Alaskan Airlines					
Assets					
Current Assets	$ 3 203	2 800	4 141	4 591	7 897
Flight Equipment	$ 4 146	4 629	5 856	8 251	11 186
— Depreciation	$ 1 743	3 125	4 026	8 307	5 390
Flight Equipment—Net	$ 2 403	1 504	1 830	2 944	5 796
Ground Property and Equipment—Net	$ 1,197	1 125	2 212	2 225	2 700
Property and Equipment—Net	$ 3 600	2 629	4 042	5 169	8 496
Deferred Charges	$ 177	130	230	172	254
Other Assets	$ 262	281	255	347	532
Total Assets	$ 7 242	8 840	8 668	10 279	17 179
Liabilities and Capital					
Current Liabilities	$ 2 685	2 571	4 878	3 449	6 255
Long Term Debt	$ 408	475	1 634	1 419	3 881
Operating Reserves	$ 175	313	388	342	777
Capital Stock	$ 1,746	1 833	2 258	2 680	2 932
Capital Surplus	$ 3 286	3 248	3 121	3 800	3 610
Earned Surplus	$ (1 073)	(2 626)	(3 648)	(1 593)	(103)
Other Liabilities	$ 45	26	37	182	127
Total Liabilities and Capital	$ 7 242	8 840	8 668	10 279	17 179
All Cargo Airlines					
Assets					
Current Assets		$5 822	9 072	8 138	21 125
Flight Equipment		$2 631	8 661	20 921	31 003
— Depreciation		$ 838	2 264	6 212	9 459
Flight Equipment—Net		$1 793	6 397	14 709	21 544
Ground Property and Equipment—Net		$ 508	1 468	1 356	2 376
Property and Equipment—Net		$2 301	7 865	16 065	23 920
Deferred Charges		$ 422	395	335	1 543
Other Assets		$ 381	3 016	281	20 292
Total Assets		$8 926	20 348	24 819	66 880
Liabilities and Capital					
Current Liabilities		$3 682	7 320	6 103	16 898
Long Term Debt		$1 531	3 443	7 345	16 887
Operating Reserves		$ 321	386	1 598	2 081
Capital Stock		$4 183	6 360	6 401	10 382
Capital Surplus		$3 135	1 732	2,352	11 992
Earned Surplus		$3 971	981	968	7 183
Other Liabilities		$ 45	126	52	1 460
Total Liabilities and Capital		$8 926	20 348	24 819	66 880

[1] Data for 1956 are as of Sept 30th

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, *for selected years (in thousands of dollars)*

	1948	1950	1952	1954	1956
Consolidated Industry					
Assets					
Current Assets	$ 253 486	316 069	449 924	486 962	561 170
Flight Equipment	$ 406 568	528 436	768 941	1 032 118	1 360 974
— Depreciation	$ 148 802	239 599	350 414	510 820	675 396
Flight Equipment—Net	$ 257 766	288 837	418 527	521 298	685 578
Ground Property and Equipment—Net	$ 92 505	75 530	97 675	110 885	148 605
Property and Equipment—Net	$ 350 271	364 367	516 202	632 153	834 183
Deferred Charges	$ 43 106	44 487	31 265	15 727	20 121
Other Assets	$ 65 361	72 025	58 974	60 560	187 862
Total Assets	$ 712 224	796 948	1 056 365	1 195 402	1 603 336
Liabilities and Capital					
Current Liabilities	$ 137 918	196 060	323 321	345 908	428 989
Long Term Debt	$ 175 206	180 583	206 214	227 292	364 318
Operating Reserves	$ 8 167	10 715	11 697	12,106	18 977
Capital Stock	$ 137 695	149 729	175 457	171 904	144 848
Capital Surplus	$ 99 173	138 420	163 688	167 915	252 029
Earned Surplus	$ 30 176	84 037	162 214	253 364	356 716
Other Liabilities	$ 123 892	37 404	13 774	16 913	40 462
Total Liabilities and Capital	$ 712 224	796 948	1,056 365	1,198 402	1,603 336

[1] Data for 1956 are as of Sept 30th

INTERCITY PASSENGER MILE MARKET

Common Carriers and Private Automobile, *1947-1956*

(Millions of Passenger Miles)

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[1]
Pullman & Air Travel										
Rail Pullman (Class I)	12 261	11 019	9 349	9,338	10 226	9 504	7 980	6 850	6 441	6 319
Domestic Trunk Lines	6 016	8 822	6 571	7 766	10 211	12 121	14 298	16 246	19 218	21 643
Local Service Airlines	46	88	135	189	290	340	391	450	523	633
Pullman and Air Combined	18 323	16 925	16 055	17 293	20 727	21 965	22 639	23 546	26 182	28 595
Airline % of Combined Total	33 08	34 92	41 77	46 00	50 66	56 73	64 88	70 91	75 40	77 90
Other Common Carriers										
Rail Coach (Class I ex. commutation)	27 660	24 315	20 273	17 443	19 524	19 758	18 955	17 687	17 314	17 054
Intercity Motor Bus Lines (Class I II III)	23 948	23 529	22 411	21 254	22 299	21 223	19 634	16 934	16 489	16 448
Total	51 608	47 844	42 684	38 697	41 823	40 981	38 589	34 621	33 803	33 502
Total Common Carrier	69 931	64 769	58 739	55 990	62 550	62 946	61 228	58 167	59 985	62 097
% Airline of Common Carrier	8.67	9.12	11 42	14 21	16 79	19 80	23 99	28 70	32 91	35 87
Private Intercity Automobile[1]	272 958	287 423	376 313	402 843	457 787	495 547	529 194	548 763	585 800	621 000
Total Common and Private Carrier	342 889	352,192	435 052	458 833	520 337	558 493	590 422	606 930	645,785	683 097
Passenger Miles per Capita[3]	2 381	2 403	2 916	3 025	3,371	3 557	3 699	3,737	3 907	4 064

[1] Partly Estimated
[2] Revised from 1949
[3] Not in Millions

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry, *1947-1956 (in Thousands of Passengers)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Trunk Airlines	12 279	12 324	14 021	15 978	20 621	22 759	26 137	29 526	34 611	37 598
Local Service Airlines	236	426	678	969	1 481	1 736	2 032	2 423	2 897	3 453
Territorial Airlines	376	418	382	477	550	515	553	661	591	627
Helicopter Airlines							1	9	29	62
International and Overseas Airlines	1 360	1 373	1 520	1 675	2 033	2 362	2 682	2 888	3 376	3 888
Alaskan Airlines		111	122	144	157	194	220	225	264	315
Total Scheduled Airline Industry	14 251	14 652	16 723	19 243	24 842	27 566	31 625	35 632	41 623	45 943

[1] Alaskan data for 1948 thru 1950 includes charter flights

AVERAGE PASSENGER FARE

Intercity Common Carriers, *1947-1956 (in Cents per Mile)*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956[3]
Domestic Scheduled Airlines										
Coach or Tourist			3.96	4.10	4.48	4.18	4.13	4.34	4.32	4.31[1]
All Services	5.04	5.75	5.75	5.54	5.59	5.54	5.43	5.37	5.32	5.30
Int'l Scheduled Airlines										
Coach or Tourist							5.77	5.83	n.a	n.a
All Services	7.77	8.01	7.72	7.28	7.13	7.05	6.87	6.79	6.69	6.70
Intercity Railroads										
First Class	2.74	3.01	3.14	3.25	3.27	3.35	3.38	3.35	3.31	3.38
Coach	2.02	2.29	2.41	2.47	2.47	2.53	2.53	2.50	2.47	2.55
Intercity Motor Busses	1.70	1.74	1.84	1.88	1.94	2.02	2.08	2.07	2.06	2.07

[1] Includes trunk local service and territorial airlines.
[2] Partly estimated
[3] Fiscal 1956.
n.a.—Not available

NEW TYPES OF AIRCRAFT IN SCHEDULED SERVICE

U. S. Domestic and International Airlines—*Operated as of December 31, 1956 and Cumulative Inventory Including Aircraft on Order through 1961*

Aircraft Type	Number In Service 12/31/56	1957	1958	1961
Boeing: 707*				70
Bristol: Britannia*			5	5
Convair: 440	19	43	43	43
880*				40
deHavilland: Comet IV*			6	14
Douglas: DC-6A, B & C	186	253	270	270
DC-7, B & C	132	211	253	253
DC-8*	—			89
Fairchild: Friendship		16	31	31
Frye: Safari		6	8	8
Lockheed: Constellation, G & H	32	51	51	51
L-1649		25	25	25
Electra*			27	116
Vickers: Viscount*	54	74	89	92

* Jet Powered

AIRCRAFT OPERATED

by U. S. Scheduled Airline Industry *as of December 31, for Selected Years*

Aircraft Type	Aircraft Used Wholly in Domestic Operations[1] 1946	1952	1954	1956	Aircraft Used Wholly in International and Overseas Oper 1946	1952	1954	1956	Aircraft Used in Both Domestic and International Operations[2] 1946	1952	1954	1956
Boeing: 247-D	4											
307-B	5				3							
377			11			28	27	25		16	10	9
Convair: 240		27	16	22		14	13	5		77	76	73
340		7	84	86		1	5	5			32	32
440				8								11
Douglas: DC-3	460	343	259	282	[illegible]	55	56	50		20	24	24
DC-4	150	80	71	61	42	50	39	48	8	55	45	34
DC-6/6A/6B		65	72	97		32	62	70		98	117	130
DC-7/7B			20	4				33			41	95
Lockheed:												
Electra	3											
Lodestar	11	11									11	10
Constellation	4	51	53	82	23	14	9	9	8	50	49	56
Super Const.		10	10	33				2		14	29	44
Martin: 202		21	25	23								
404		96	100	97								
Vickers Viscount				54								
Total	647[3]	706	711	821	146	198	208	247	16	330	434	518

[1] Includes Domestic Trunk and Local Service Carriers
[2] Trunk Airlines who operate both Domestic and International Routes usually have their aircraft certificated for both operations in order use these aircraft internationally
[3] Total Domestic for 1946 includes 10 Stinsons

Aircraft Type	Domestic 1946	1952	1954	1956	International 1946	1952	1954	1956	Both 1946	1952	1954	1956
Helicopters:												
Bell: B-47		6	6	7								
Sikorsky: S-51		3	3	2								
S-55		5	11	8								
S-58				3								
Total		14	20	20								

AIRCRAFT OPERATIONS AT CAA AIRPORT TOWERS

1947-1956 (in Thousands)

Type of Flight Operation	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Military	1 595	2 259	2 780	2 384	2 852	2 983	3 712	4 409	4 975	5 075
Civil	13 221	12 877	10 446	9 585	9 618	7 965	7 719	8 015	8 540	9 107
Air Carrier	2 854	3 242	3 713	4 002	4 556	4 865	5 384	5 512	5 983	6 202
Total	17 670	18 378	16,939	15 971	17,026	15 814	16 815	17 945	19 480	20 384
% Air Carrier of Total	16.2	17 6	21 9	25 1	26 8	30.8	32 0	30.8	30 7	30 4

NOTES: Air Carriers include scheduled and non scheduled operations
Each landing is counted as an operation as is also each takeoff
Fiscal Year

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatality Rate *per 100 000 000 Passenger Miles, 1947-1956*

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Domestic Scheduled Airlines										
Fatalities	199	83	93	96	142	46	86	16	156	144
Rate	3 28	1 40	1 39	1 21	1 36	37	.59	.10	.79	.64
International and Overseas Scheduled Airlines[1]										
Fatalities	20	20	4	48	43	94	2	0	2	10
Rate	1.08	1 02	19	2 10	1.59	2.98	06	..	04	19
Motor Buses										
Fatalities	140	120	120	100	130	100	70	60	100	n.a.
Rate	21	.18	.20	.17	.22	16	.13	.11	.19	n.a.
Railroad Passenger Trains										
Fatalities	75	52	29	184	150	14	50	23	19	52 p
Rate	.16	.13	08	58	43	04	16	08	07	.19 p
Passenger Autos and Taxis										
Fatalities	18 300	15 200	15 300	17 600	21 000	22 600	23 500	22 500	24 700	n.a.
Rate	2.3	2 1	2 0	2 2	2 4	2.8	2 9	2 6	2 7	n.a.

[1] Alaska data not included for 1947
n.a.—Not Available.
p—Preliminary

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

At the present time there are seven recognized classes of air carriers in the air transport industry of the United States. This classification is used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Civil Aeronautics Act is based largely on the scope of operations authorized or allowed by that Act. Classes One to Six have certificates of convenience and necessity and conduct regularly scheduled services.

1. The Domestic Trunk Lines include those air carriers which presently have permanent operating rights within the continental United States. These rights derive largely from operations by present or predecessor companies antedating the Civil Aeronautics Act of 1938 which granted them "grandfather rights." There are currently twelve trunk lines, most of which operate high density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta	Northeast	United
Capital	Eastern	Northwest	Western

2. The Domestic Local Service Lines have, with one exception, been certificated since 1945. These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers. The thirteen local service lines in 1955 were

Allegheny	Lake Central	Ozark	Southwest
Bonanza	Mohawk	Piedmont	Trans Texas
Central	North Central	Southern	West Coast
Frontier			

3. The International and Overseas Lines include all U. S. flag air carriers operating between the United States and foreign countries other than Canada. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean.

Alaska	Eastern	Pacific Northern	South Pacific [2]
American	Mackey [2]	Pan American	Trans World
Braniff	National	Pan American-Grace	U. M. C. A. [2]
Caribbean Atlantic	Northwest	Resort [1]	United
Delta		Samoan [2]	

4. The Territorial Lines include two groups of carriers. The Insular Lines operate in the U. S. island possessions in the Pacific and the Caribbean and the Alaskan Lines operate between the U. S. and Alaska and within Alaska.

Insular Lines	Alaskan Lines			
	Operating between the U. S. and Alaska		Operators within Alaska	
Hawaiian	Alaska	Pacific Northern	Alaska	Howard J. Mays
Trans Pacific	Northwest	Pan American	Alaska Coastal	Northern Consolidated
			Bristol Bay	Pacific Northern
			Cordova	Pan American
			Ellis	Reeve Aleutian
				Wien

5. The Helicopter Airmail Lines presently operate between airports, central post offices, and suburbs in New York, Chicago and Los Angeles. Originally certificated as exclusive mail carriers they now fly passengers, air freight and air express. These carriers hold temporary certificates and are considered to be experimental in nature.

Chicago Helicopter Airways	Los Angeles Airways	New York Airways

6. The All Cargo Lines operate under temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another to Europe. These carriers cannot carry either regular air mail or passengers.

Aerovias Sud Americana	Flying Tigers	Seaboard & Western
American Air Export and Import	Riddle	Slick

7. Non-Certificated Air Carriers include a diversified group of operators who, with the exception of the air taxi operators and air freight forwarders, are not authorized to engage in regularly scheduled service. They are described in the CAB 1954 Annual Report as follows

Operators of various types of air services have been authorized by the Board through the exemption process, rather than through the requirement that a certificate of convenience and necessity be obtained. At present this group includes

Supplemental and irregular transport carriers 49
Air freight forwarders 80

[1] Certificated cruise carrier
[2] Certificated non mail carriers.
[1, 2] Statistical data of these carriers are not included in the statistical tables.

April 22 1957

AIR TRANSPORT ASSOCIATION OF AMERICA

18TH EDITION
Facts and Figures, 1957

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The Flying Tiger Line, *Robert W. Prescott, Pres., Lockheed Air Terminal, Burbank, California*
Frontier Airlines, *C. A. Myhre, Pres., Stapleton Airfield, Denver 7, Colorado*
***Hawaiian Airlines,** *A. D. Lewis, Pres., Honolulu International Airport, Honolulu 17, T. H.*
Lake Central Airlines, *Gunn Hicks, Pres., Weir Cook Municipal Airport, Indianapolis 44, Indiana*
Los Angeles Airways, *C. M. Belinn, Pres., Box 45155, Airport Sta., Los Angeles 45, California*
Mackey Airlines, *Joseph C. Mackey, Pres., Broward County Int'l Airport, Ft. Lauderdale, Florida*
Mohawk Airlines, *Robert E. Peach, Pres., Cornell University Airport, Ithaca, New York*
National Airlines, *G. T. Baker, Pres., 3240 N. W. 27th Avenue, Miami 42, Florida*
New York Airways, *Robert L. Cummings, Jr., Pres., P. O. Box 426, LaGuardia Airport Station, Flushing 71, New York*
North Central Airlines, *Hal N. Carr, Pres., 6201 34th Ave., South Minneapolis 23, Minn.*
Northeast Airlines, *George E. Gardner, Pres., Logan Int'l. Airport, E. Boston 28, Mass.*
Northern Consolidated Airlines, *Raymond I. Petersen, Pres. & Gen. Mgr., 414 Fourth Avenue, Anchorage, Alaska*
Northwest Airlines, *D. W. Nyrop, Pres., 1885 University Avenue, St. Paul 1, Minnesota*
Ozark Air Lines, *Laddie H. D. Hamilton, Pres., Box 6007, Lambert Field, St. Louis 21, Missouri*
Pacific Northern Airlines, *A. G. Woodley, President, 1626 Exchange Building, Seattle 4, Washington*
Pan American-Grace Airways, *Andrew B. Shea, Pres., 135 E. 42nd Street, New York 17, New York*
Pan American World Airways, *J. T. Trippe, Pres., 135 E. 42nd Street, New York 17, New York*
Piedmont Airlines, *T. H. Davis, President, Smith Reynolds Airport, Winston-Salem 1, N. C.*
Reeve Aleutian Airways, *Robert C. Reeve, Pres. & Supt. Operations, 420 D Street, Box 559, Anchorage, Alaska*
Resort Airlines, *Harold L. Graham, Jr., Pres., Suite 326, 1346 Connecticut Ave., N. W., Washington 6, D. C.*
Riddle Airlines, *John Paul Riddle, Pres., P. O. Box 535, Miami International Airport Branch, Miami 48, Florida*
Seaboard & Western Airlines, *Raymond A. Norden, Pres., 80 Broad Street, New York 4, New York*
Slick Airways, *D. W. Rentzel, Chairman of the Board, P. O. Box 9547, Oklahoma City, Oklahoma*
Southern Airways, *Frank W. Hulse, Pres., 1140 Brown-Marx Building, Birmingham, Alabama*
Southwest Airways Company, *John H. Connelly, Pres., San Francisco International Airport, San Francisco, California*
***Trans-Canada Air Lines,** *W. Gordon Wood, Vice President-Traffic, Room 422, International Aviation Bldg., 1080 University Street, Montreal 3, Quebec, Canada*
Trans Texas Airways, *R. E. McKaughan, Pres., 1221 Commerce Building, Houston 2, Texas*
Trans World Airlines, *Warren Lee Pierson, Chairman of the Board, 806 Connecticut Avenue, Washington 6, D. C.*
United Air Lines, *W. A. Patterson, Pres., 5959 S. Cicero Avenue, Chicago 38, Illinois*
West Coast Airlines, *Nick Bez, Pres., Boeing Field, Seattle 8, Washington*
Western Air Lines, *T. C. Drinkwater, Pres., 6060 Avion Drive, Los Angeles 45, California*
Wien Alaska Airlines, *Sigurd Wien, President & General Manager, Box 649, Fairbanks, Alaska*

*Associate Member

Printed in U.S.A.

AIR TRANSPORT ASSOCIATION OF AMERICA
1107 SIXTEENTH ST. N.W. WASHINGTON D. C.

New B-58 America's First Supersonic Bomber...

gets Heat-Resistance, High Strength from ARMCO 17-7 PH STAINLESS

Components of Convair's new "Hustler" made of Armco 17-7 PH Stainless to assure strength in "hot spots."

Powered by four afterburner jets, the B-58 is designed to sweep through the sky at supersonic speeds. This new delta-winged Convair bomber is a potent addition to American air power. Its design demanded high performance aircraft materials, especially for highly stressed parts subject to both aerodynamic and jet engine heat.

Because of this, Convair engineers specified Armco 17-7 PH Stainless Steel in parts where operating temperatures are critical. By using this special stainless steel for brazed honeycomb sections as well as formed structural elements, they obtained the required strength, lightness and resistance to heat.

Offers Formability Plus High-Temperature Strength

On a strength-weight basis at temperatures up to 900 F, Armco 17-7 PH is one of the strongest aircraft materials available. Guaranteed minimum room-temperature tensile properties of 180,000 psi ultimate and 150,000 psi 0.2% yield in Condition TH 1050, and 200,000 and 180,000 psi in Condition RH 950, assure a reliable design basis.

Besides excellent mechanical properties, Armco 17-7 PH possesses exceptionally good workability. In the annealed condition it can be readily stretch- or press-formed, drawn and welded. Then, after fabrication, its high mechanical properties are fully developed by a simple heat treatment.

Widely Used

Because of its unusual combination of properties—high strength, resistance to heat, excellent fabricating characteristics and corrosion resistance—Armco 17-7 PH Stainless is widely used in supersonic jets and long range missiles.

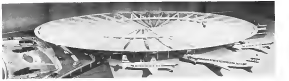
Consider how the advantages of this unique stainless steel, available in sheet, strip, wire and plate, can be utilized to help solve your design and production problems. For information on the properties and fabrication of Armco 17-7 PH Stainless Steel, write us at the address below.

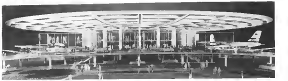
(Note: A companion grade, Armco 17-4 PH, is supplied in bar and forging billets.)

Typical brazed stainless steel honeycomb sections used in the B-58. Both core and cover sheets are Armco 17-7 PH Stainless.

Sheffield Steel Division
Armco Drainage & Metal Products, Inc.
The Armco International Corporation

ARMCO STEEL CORPORATION
1007 CURTIS STREET, MIDDLETOWN, OHIO





SCALE MODEL shows how Pan Am terminal would be approached from one of eight lanes allowed for vehicular traffic. Terminal would handle over 1,000 cars or taxis an hour. Passengers would unload on second floor level, proceed under cantilever roof to plane.

Pan Am Plans "Umbrella" Terminal

By George L. Christian

New York—Air terminal of completely new concept, designed to handle a fully loaded 160-passenger airliner every 15 minutes, will be erected by Pan American World Airways at New York International Airport.

The $8 million structure, to be built at the right side of the International Arrival Building, features slim concrete columns supporting a huge umbrella-like cantilever roof with a 110 ft. overhang under which departing and arriving planes will be stationed. Glass walls on all four sides provide unrestricted view in all directions. The structure will cover an area of four acres.

Cantilever roof construction will use an exposed steel cable suspension system similar to that of Pan American's new hangar being built at Idlewild. Trans World Airlines has moved into a hangar at Kansas City whose roof is steel cable-supported, and a second, similar hangar is under construction at Idlewild, indicating a trend to steel cable supported structures in the airline industry (AW Jan. 7, p. 107).

TWA will erect its terminal on the left of the International Arrival Building.

It will not yet reveal its plans for the building which, it claims, will be super modern.

PAA's terminal will serve primarily as a departure terminal. Only arrivals to use the facility will be those passengers who do not have to clear through customs and immigration—such as arrivals from Puerto Rico. Planes carrying passengers who have to clear customs will use the International Arrival Building.

Purely Functional

The structure, purely functional in design, eliminates two common major defects of most large airline terminal buildings: requiring passengers to walk long distances through deadly "sheep runs" to get to planes, and being exposed to wind and weather while trudging from terminal to plane.

PAA's solution to these two vexing problems:

- Broaden the finger into an overall terminal large enough to accommodate six four-engine airliners. A spillover area provided at one end of the oval, is capable of accommodating one or two additional planes in case of an unforeseen jam-up. With such an arrangement, passengers can emplane directly from a comfortable lounge.
- Place over the terminal a mushroom-like roof with giant eaves extending 110 ft. over the plane parking area, permitting passengers, luggage, cargo and mail to be loaded under cover.

Idea Borrowed

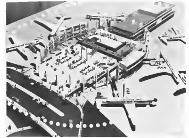
PAA borrowed and bettered the cantilever roof feature from Berlin's Tempelhof Field Terminal which was built in the early thirties. Additional cost for such a design over a conventional terminal is about $2 million, according to Harold E. Gray, executive vice president of Pan Am's Atlantic Division.

Here is how the terminal will streamline a departing passenger's arriving and boarding procedure:

Passengers arriving by limousine or car are brought to the second floor of the terminal. Eight, 150-ft. vehicular lanes are provided to accommodate about 1,800 cars an hour.

Usual, heavy entrance doors which passengers have to shove open with their hands full of baggage, have been eliminated. Instead, a 100-ft.-wide "curtain of air," which flows downward from overhead ducts to slots in the floor, will keep terminal temperatures at the desired level.

PAA will provide 48 check-in positions to eliminate weighing-in delays. Positions will be within 40 ft. of the



ALL AIRCRAFT will be visible from the lounges of new terminal. Four acres will be under roof; 48 check-in positions will be within 40 feet of the terminal entrance

terminal entrance to save passengers having to carry their luggage any great distance

Main waiting room on the second floor will have over 500 lounge seats compared to the 358 seats currently available for all airlines at La Guardia Field

Restaurant, coffee shop, bar, observation deck and additional lounges will be on a mezzanine straddling the main concourse.

Enplane From Second Floor

Passengers will enplane from the terminal's second floor to the planes' cabin level on raised passageways This eliminates walking through the grease and water puddles so often present on airport aprons, and climbing steep stairs into the plane

Passageways are mounted on self-propelled "truck ramps" which will be specially built for Pan Am Contract has not been let

Other advantage of the second floor to plane boarding procedure is that the terminal's ramp is left entirely to aircraft service personnel who can therefore perform their jobs such as loading and unloading baggage, much more quickly and efficiently

For arriving passengers, PAA has established a specification that no one will have to wait more than five minutes for his luggage

Gray told AVIATION WEEK that jet transports will taxi into position at the terminal, but will be towed away from the terminal to originate a flight or go to the hangar Reason is to avoid the noise and jet blast under the overhanging eaves Also, it would not be practical to maneuver jets so close to other aircraft while under their own power

When asked what Pan American planned to do with the terminal if the Port of New York Authority persisted in its current ban of jets at Idlewild Gray replied, "This building could make the fanciest supermarket you have ever seen"

The air-conditioned structure, to be erected on a 17-acre site, will contain approximately 100,000 sq ft of floor space, about half of which will be devoted to passenger facilities

The building, which will be completed late in 1958 was designed by Tippetts, Abbett, McCarthy and Stratton, New York architectural and engineering firm Associate architects were Ives, Turano and Gardner

Engineer: Arresters For Jets Feasible

Safety arresters to accommodate commercial jet aircraft are feasible at the present time," Charles J Daniels of All American Engineering Co, recently told the aeronautic meeting of the Society of Automotive Engineers

"Development of aircraft arrestment equipment for the military during recent years has extended the state of the art into an area which exceeds the requirements for commercial safety over run arresters"

Daniels said that the water squeezer is an ideal arresting engine for use with commercial jets with weights ranging from 100,000 300,000 lm and landing speeds up to 120 kt

Advantages of the system are-

TACAN unit shown with covers removed; plane is a composite model.

• **Machine requires** no adjustments regardless of speed or weight—provided they are within design limits.

• **Diameter** of water-filled tubes through which pistons are pulled, can be varied to program retarding force and stopping distance to desired values.

• **Pre-set or stored** high pressure air or water charges—which might leak and cause malfunctioning—are not needed.

• **Underground installation** would remove the engine as an airport obstacle. This would also reduce possibility of water freezing. If necessary, anti-freeze may be added without affecting the engine's operation.

• **Resetting the water** squeezer is inexpensive and fast.

All American Engineering has made a preliminary design of a water squeezer for use with jet commercial aircraft weighing from 100,000-300,000 lb. and engaging at speeds of ranging from 0-120 kt. Here are some of the data: cable dia—1½ in., piston dia—13 in., tube length—875 ft., tube max. dia—21 in., min. dia—13.5 in., working pressure—800 psi.

Such an engine would stop these aircraft in 1,000 ft.: plane weighing 300,000 lb. landing at 120 kt. and imposing .8G, plane weighing 100,000 lb., landing at 120 kt. and imposing 1.5G.

Retraction time for the cable is about 15 min.

Temco Orders New Ejection Seat Type

Los Angeles—Hardman Tool and Engineering Co., Los Angeles, has received initial order for 30 new type ejection seats from Temco Aircraft Corp. Seats are scheduled for installation in Temco's TT-1 primary jet trainer.

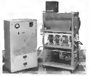
They are first of this type to use the integrated ejection seat system developed by Navy and Douglas Aircraft's El Segundo division.

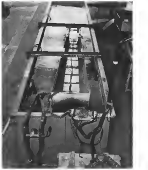
Design eliminates need for adjustable head and foot rests. Integrated pilot restraint system attaches to shoulder harness inertia reel which allows pilot freedom of movement, yet assures immediate arrest of forward movement, plus instant separation following ejection or ditching.

System has undergone extensive testing. Seat is designed for 25G ejection load and 40G crash load. It has withstood 60G deceleration in tests.

Pesco Products Goes to Accessories Exclusively

Pesco Products Division, Borg-Warner Corp., will devote its energies exclusively to engineering and production of aircraft accessories. The former Industrial Division has released 312,631 square feet of floor space at the Pesco Bedford, O. plant for the production of such aircraft accessories as fuel and fuel booster pumps, hydraulic pumps, air pumps and electrical accessories for military and commercial planes.





SPRAYMAT APPLIED to Britannia elevator horn balance undergoing element uniformity checks (left) Special rig for mechanically spraying the elements of the Britannia tail unit heaters (above, left) Functional testing a fin leading edge heater, using water cooler (right)

Flame-Sprayed Elements Aid Britannia Tail Surface De-Ice

London—De-icing system originally applied only to the elevator horn balances of the Bristol Britannia proved so effective and simple it also was adopted for leading edges of the fin and tailplane

The electrical heater system—"Spraymat"—consists of flame-sprayed metal elements sandwiched between layers of insulating material, the base insulation acting as an adhesive to secure the heater to the component.

Two main types are in use Both employ flame-sprayed conductor elements of either aluminum or Kumanal and sprayed copper busbars to carry the current from one element to the next at each change of direction.

Spraymat Type 1 heaters employ a flame-sprayed insulation compound which is oven-cured at a temperature of 180C Insulation of Type 2 heaters is applied as a liquid with layers of glass cloth acting as a bonding agent the curing temperatures being between 50 and 100C

Under icing conditions, the Britannia elevator horn balances are heated continuously by Type 1 heaters operating from 112-volt DC system, each heating an area of 3 56 sq ft and having a power loading of 3 08 kw The heating intensity is graded in six steps from a maximum of 15 watts/sq in at the nose to 4 watts/sq in at the root

For the leading edges of the fin and tailplane Type 2 heaters with cyclic de-icing are used

Each tailplane heater has an effective area of 53.5 sq ft and contains 15 independent heater circuits The fin heater contains 11 circuits and covers an area of 32 6 sq ft All the circuits operate from the 208-volt ac 3-phase supply at a voltage to neutral of 107 volts The maximum power loading is 20 5 kw, the heating intensity being graded in each case from 13 watts/sq in to 7 watts/sq in over the surface of the heater

Layout of the tail unit heaters provides for the heating of selected areas in a given order and makes provision for proportionate load-shedding in a given order in event of an alternator failure Heaters are divided into 16 cyclically heated areas, four on the fin and six on each tailplane, each area being subdivided into a primary and a secondary zone

Continuously heated breaker strips on the extreme leading-edges prevent the formation of ice caps which might be held in place by air loads, and similar chordwise parting strips ensure clean shedding from each de-iced area

Two cyclic switches are used to control the primary and secondary areas In normal operation, the current is

FIN LEADING EDGE before application of outer insulation, showing element paths, busbars

switched to each primary area to detach ice that has formed by water droplets freezing on impact

On changing over to the second cyclic switch, the primary and secondary zones of each area are heated in turn thus detaching any ice that may have formed as a result of water running back from the heated primary zones and freezing

Cyclic de-icing of large areas of airfoil surface greatly reduces the amount of power required compared with continuous heating If all 41 circuits in the Britannia tail unit heaters were operated simultaneously the total power required would be more than 220 kw

Germany Trains New Air Force

Iron Cross of the new West German Air Force marks American built T-33s at a jet training base in Germany. Germans are buying foreign military planes for force

WHAT'S NEW

Publications Received:

- **1956 Aircraft Year Book**—Official Publication of the Aircraft Industries Assoc, Inc—Edited and Published by Lincoln Press, Inc, 1143 National Press Bldg, Washington 4, D C $6.00, 484pp

Complete review of the events and developments in military and civil aviation in the United States

- **Instrument Flying**—by P V H Weems and Charles A Zweng—Pub jointly by Weems System of Navigation, Annapolis, Md, and Pan American Navigation Service North Hollywood, Calif $6.00 208pp

New and revised sixth edition of a guide to instrument flying for pilots and students

- **Famous Fighters of the Second World War**—by William Green—Illustrated by G W Heumann—Pub by Doubleday & Company, Inc, Hanover House 575 Madison Ave, New York 22, N Y

Detailed histories of the most famous World War II fighter aircraft as used by the air forces of Britain, the United States, Germany and Japan. (Publication date April 4, 1957.)

- **Management for Growth**—Edited by Gayton E Germane, Associate Professor of Transportation and Director, Transportation Management Program—Pub by Graduate School of Business,

Stanford University, Stanford, Calif 126pp.

Book is first of a projected annual series, based on presentations made by guest speakers at the annual Stanford Transportation Management Program

• **Post-War International Civil** Aviation Policy and the Law of the Air—by H A Wassenbergh—Pub by Martinus Nijhoff, The Hague, Netherlands. 180pp

Discusses problems that arise in the field of force between politics and law in connection with the regulation of civil aviation throughout the world

• **Wing Leader**—by Group Captain J E. Johnson, D S O , D F C —Pub by Ballantine Books, 101 Fifth Ave., New York 3, N Y Paperbound 50¢, 292pp

Group Captain Johnson's account of nearly five years of fighting in the air—from the Battle of Britain to victory in Germany

• **The World's Fighting Planes**—by William Green & Gerald Pollinger—Pub by Doubleday & Company, 575 Madison Ave , New York 22, N Y $3 50. 240pp

Completely revised edition of this manual contains specifications history performance, and armament data of every military plane in flight and in active use today, regardless of age

• **Airpower**—The Decisive Force in Korea—Edited by James T. Stewart, Colonel, USAF—Pub by D Van Nostrand Co , Inc 120 Alexander St , Princeton, N J $6 50 310pp

After an overall discussion of the air war by General O P Weyland, this book analyzes specific techniques in three areas the fight for control of the skies, applied airpower against the enemy on the ground, support elements which made possible the air operations.

• **Physics in Meteorology**—by A C Best—Pub by Pitman Publishing Corp 2 West 45th St , New York 36, N Y $3 75, 159pp

Purpose of this book is to show that meteorology is one branch of physics the author demonstrates this by describing and explaining a selection of meteorological phenomena in terms familiar to the student of physics

• **The Aeroplane Directory**, 1957 edition—Compiled by the Staff of The Aeroplane—Pub by Temple Press Ltd , Bowling Green Lane, London, E C 1 21/-net, approx. $3 00, 603 pp

Complete guide to aviation throughout the British Commonwealth, its air forces, ministries, organizations, airlines, industries, flying clubs and aerodromes, along with a biographical section containing over 1,550 entries

Douglas Division Expects Record Year

Douglas Aircraft Co 's El Segundo Division is scheduled to deliver a new peacetime high of more than 600 airplanes during 1957, according to Arthur E. Raymond, Douglas vice president engineering This adds up to one of the division's biggest tasks and most productive years, and one of the biggest dollar volumes in its history, Raymond said in a talk at the 25th anniversary meeting of the Douglas El Segundo Management Club

Raymond did not identify the aircraft but these will include A3D Skywarriors A4D Skyhawks F4D Skyrays, and F5D Skylancers (two more will be built this year in addition to the two previously built Raymond revealed that the Sparrow II missile was designed for specific use on the F5D by Douglas' Santa Monica Missiles Engineering Dept

Boar project was identified by Raymond as an El Segundo activity There was no further elaboration on this project but apparently it was in reference to an atomic warhead missile in both the air-to-air and air to surface categories which had been developed by Douglas for Navy Bureau of Ordnance

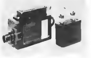
Missiles and Weapons Section had been established at Douglas El Segundo on March 1, Raymond said encompassing armament fire control, missile compatibility and missile design functions The section, he revealed, has immediate responsibility for determining the compatibility of all existing missiles to Douglas El Segundo aircraft to establish missile requirements to future aircraft designs, and to take on any new missile developments or production.

Douglas is now negotiating for construction of a high Mach number 6x6 ft wind tunnel to be erected at a cost of $8 8 million on a 10 acre site to the south of the El Segundo main plant

Raymond declared that El Segundo was involved in the design of a new attack airplane in competition with other airplane manufacturers If Douglas wins this competition the plane would be given the designation A5D

"The Navy seems destined to take over part of the job previously handled by the Air Force," Raymond said "I am referring to some of the tactical missions the brush fire type of operation in a circumscribed area with limited objectives. With the Air Force placing emphasis on the concept of massive retaliation there would appear to be an increasing field open to the Navy Aircraft carriers with attack bombers aboard can have a powerful persuasive effect in certain areas of the world if it becomes necessary for us to flex our muscles a bit "

NEW AVIATION PRODUCTS



Versatile Record Cameras

TN 9 modification of Bell & Howell N-9 camera is designed for versatile range of instrumentation recording work. Three basic designs are available: TN-9 standard, TN-9A automatic exposure control model and TN-9B pulse operated interval version.

Features include strip or streak operation, conversion to slow speeds of 12, 24, 48 fps to single high speed of 100 fps, conversion for operating under 100G loads and use in scope recording.

Traid Corp., 17136 Ventura Blvd., Encino, Calif.

Camera Revolves 360 Deg.

Designed to permit accurate measurement of azimuth angles in spite of differential shrinkage of film or prints, 360-deg. horizon camera turns through complete arc in about minute, driven by 24-v. battery.

Unit was initially used at Distant

Early Warning line to predict radar or micro-wave patterns at station areas, can also be used for plane table work or similar applications. Film capacity is about 400 ft.

Aero Service Corp., Philadelphia, Pa.

Airborne Electronic Relay

High temperature airborne electronic relay 204W1 features active getter to absorb residual gas and organic vapors, providing improved operation over ambients of −65C to +125C and under low current and low voltage in addition to full loads.

Palladium contacts are utilized on the six-pole double-throw miniaturized and hermetically sealed unit, made to meet MIL-R-5757. One-piece extruded can with two integral mounting flanges guards against high frequency vibration, shock and salt spray. Unit measures 1.75 in. high, is 1⅛ in. diameter and weighs under three ounces.

Radio Corporation of America, Components Division, Camden, N. J.

Aerial Drop Platform

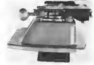
Air bag shock absorbers are featured in aerial drop platforms which range in size from smallest unit capable of accommodating 5,000 lb. loads to largest type capable of handling 20,000 lb. Platforms, produced under Wright Air Development Center contract, are constructed of magnesium with air bags supplied by Aviation Products Division of Goodyear Tire & Rubber Co. Diaphragms control escape of air to prevent blowouts and sudden landing shocks; variable diameter orifice provides controlled deceleration.

Brooks & Perkins, Inc., Detroit, Mich.

Emergency Scoop for Fumes

Ram emergency air scoop was designed to disperse rapidly unanticipated quantities of smoke, oil-mist and the like entering cockpit where regular ventilation system failed to handle material quickly enough.

Fuselage contoured, device can be opened or closed to any of six settings using a hand lever, allowing openings



into the slipstream from one-eighth to three-quarters of an inch. When pilot opens the scoop, integral miniature switches control cabin pressurization and air conditioning system, cabin pressure dump valve. Ram air passes through two spring-loaded check valves provided to prevent reverse flow through the unit when scoop is closed.

Pilots of several major aircraft manufacturers have started to use the scoop for short, low-altitude flights.

William R. Whittaker Co., Ltd., 915 North Citrus Ave., Los Angeles 38, Calif.

Optical Tooling Unit

Telescopic alignment kit for use with General Precision Laboratory's standard PD-150 closed-circuit television system provides precise visual communication in optical tooling setups.

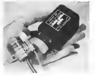
TV camera allows one man to align fuselage or wing frames, with the unit taking the place of an observer behind

a telescope; cross-hairs in each frame are lined up with a light-source cross-hair by watching the pictures on a monitor screen. Additional cameras and alignment kits can be used when the application requires more than one set of cross hairs to establish definite plane; the aligner can refer to any one of the cameras by pushing a selector button.

General Precision Laboratory, Inc., Pleasantville, N. Y.

Long Life Fire Detector

Visual fire detection system, with detector portion designed to last the life of the plane, signals alarm in less than 15 min. after start of blaze, the manufacturer reports. Sensitivity is established to detect a five-inch pan of burning



fuel at five-foot distance, the system provides complete discrimination against sunlight and all forms of interior lighting

System weight is one pound including control unit and six detectors Standby current is 100 ma. at 28 v d c and the system will operate between 18 and 34 v d c Estimated continuous operating life is 10,000 hr., ambient temperature range is −65 to 300F later versions designed to handle higher temperatures are under development

Pyrotector, 349 Lincoln St, Hingham, Mass

Oxygen Trigger Valve

Automatic oxygen trigger valve works at predetermined altitude setting so that if cabin decompression occurs, the airplane's oxygen system is activated Valve is a component of company's automatic "drop-out" oxygen system,

compartment doors open instantly when pressure drops, with oxygen masks falling in front of each passenger Flow to mask begins when passenger pulls mask toward face

Scott Aviation Corp., Lancaster, N Y

Arming Solenoid Goes High

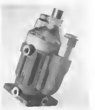
Arming solenoid that operates unpressurized to high altitudes has been fully qualified to 80,000 ft and successfully tested at 115,000 ft Weighing 11 oz., its normal power drain is 0 7 amp and it operates down to 18 v At

—65 deg and 29 v d c, power drain is 1 amp Operating temperature is —65 to +250 deg

Fairchild Engine & Airplane Co, Western Branch, Stratos Division, Manhattan Beach, Calif.

Hydraulic Pump for 5,000 Psi.

Successful operation of an advanced version of Model 66W Stratopower aircraft hydraulic pump for over 1,000 hr of cycling endurance at 5,000 psi is reported for new design Latest equipment delivers approximately 7 5 gpm at 3 750 rpm and is within one-quarter pound in weight of a standard pump



rated for this flow at 3 000 psi, the manufacturer states

Tests of the new pump included Mil 0 5606 oil at 160F and inlet pressure sea level Cycling was once per minute from full flow pressure of 4 500 psi to non-flow at 5,000 psi Applications would include normal operating ranges of 3,000 3,750 rpm

Watertown Division, New York Air Brake, Watertown, N Y

Official Photo U. S. Navy

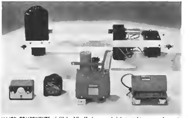
Autopilot Features Magnetic Lock-on

By Erwin J. Bulban

New York—Globe Mk. II single axis autopilot, featuring magnetic heading course lock-on and anti spiral stability, will be available to lightplane owners in June for under $1,500 installed

Unit is the second item in a series of building blocks programmed by Globe Industries, Inc., Dayton, Ohio, which eventually will provide a fully automatic flight control system for business pilots Initial unit in the system was Globe's Gyro/Stabilizer Mk. I, the spiral stability portion Current owners of this unit can add the new second portion, giving magnetic heading control, at a conversion cost of $725

Globe Mk. II is currently CAA approved for Cessna 170, 172, 180 and 182, Piper Tri-Pacer series approvals are pending the manufacturer reports



MAJOR COMPONENTS of Globe Mk. II, foreground, left to right command console, remote compass indicator (optional) servo actuator and rate gyro At top is heading lock-magnetic compass and signal amplifier assembly

Magnetic Compass

Heart of the system is a precision magnetic compass especially stabilized to reduce northerly turning error Globe chose a magnetic compass over a directional gyro in order to make its Mk. II independent of the operator's existing instrumentation and also to avoid drift characteristics of a directional gyro Accuracy of the magnetic compass is enhanced by mounting behind the baggage compartment

Purchasers can also get an instrument panel indicator for remote reading of the magnetic compass as optional equipment price of this item has not yet been decided

Command console, measuring four inches wide x 2½ in high x 2¼ in deep clamps onto the airplane's control wheel hub, optional mounting can be on the instrument panel or on the ceiling

Choice for Pilot

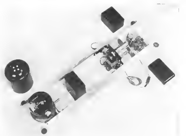
Arrangement of the controls provides the pilot with an option of using the Mk. II as a Gyro/Stabilizer or autopilot with heading sense and memory To use as a Gyro/Stabilizer, the function switch (on left of console) is turned to "GS" and the push pull control is operated to engage the unit Warm up time for this portion of the system is two seconds Stabilized turns at a rate of up to three degrees per second are possible by turning the trim turn knob the right of the console

The remote compass indicator is activated alone by moving the switch on the left to "STBY", without engaging the unit After this is done, the system is locked onto a heading with the following procedure

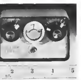
- **Engage the system** with the push-pull control
- **Adjust trim-turn knob** for straight flight on the desired heading
- **After 60-sec warm-up,** move the heading trim switch, at bottom center, toward the off-centered needle
- **Turn function knob** to "HL"

When used in conjunction with the Gyro/Stabilizer, function knob is moved to "STBY" after unit engages

After the magnetic heading is set



MECHANISM of magnetic heading lock assembly is detailed with cover plates removed left to right magnetic compass, heading lock servo having two Globe miniature precision motors, compass feedback system and transmitter for optional compass indicators, error signal amplifier



COMMAND CONSOLE is mounted in cockpit. Function selector switch (left) heading trim togglemeter and toggle switch (center) and turn control for stable turns (right).

into the unit, it is retained until the pilot changes or overrides it. He changes heading by pushing the heading trim switch to either the left or right, the airplane changing course at a rate of one degree per second, for three degree rate of turn, he puts the unit on "STBY" and rotates the trim turn control in the direction desired

Heading retention is accomplished by photo-electric pickoffs in the compass, which sense changes, amplify these error signals and feed them to a servo, which in turn induces a signal in the Gyro/Stabilizer system correcting rudder

Hunting Clan Orders DC-6As to Use in Africa

London—Two Douglas DC-6A Liftmasters have been ordered by Hunting Clan Air Transport at a cost of $3.3 million with spares, for delivery in 1958.

The independent airline disclosed at the same time that it has sold to Icelandair the two Viscounts which have been standing idle at London Airport since the government refused permission several months ago for the airline to use them on "colonial coach" service to Africa Hunting Clan also has sought to buy Central African Airways without success

The Douglas aircraft will be used primarily on all-freight service between Britain and Africa, replacing York aircraft now used

Executive Turboprop

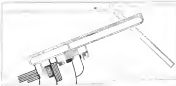
Los Angeles—On Mark Engineering Co., Van Nuys, Calif., will soon unveil an adaptation of the Douglas B-26 to a pressurized, turboprop executive transport Airplane will have almost wholly new cylindrical fuselage, reworked wings Tail assembly will retain original configuration. Probable powerplant is Allison 501D, with Aeroproducts propeller

U. S. Group Backs Brazil Lightplane

Rio de Janeiro—Two Brazilian state owned companies are combining forces to produce a diversified line of light aircraft with financial support from private U S business sources The American group is interested in backing the venture by supplying $1.5 million in equipment, provided the Brazilian firms production plans are approved by their country's air force and its equivalent of the U S Civil Aeronautics Board

A four-place lightplane for air taxi and business plane use, resembling Cessna designs is being readied for production by the companies

One of the firms, OMAREAL, is now producing a two-place trainer, the Paulistinha Brazil's air force reportedly has ordered 20 and may purchase additional Paulistinhas Sociedade Constructora Aeronautica Neiva Ltda, the other manufacturer, is completing prototypes of two and four-place aircraft The Brazilian air force has ordered two prototypes of a tandem seat high wing liaison/observation plane from the company



PRIVATE AIRPORT near Dallas, Tex. will have 4,500 ft. hard surface runway

Dallas Businessmen Building $2.3 Million Private Airport

Dallas—A new $2.3 million private airport is under construction near here, designed to handle the increasing volume of executive flying in Dallas area.

The new field is on a 400 acre tract in Addison about 15 mi. north of downtown Dallas. It will be ready for flight operations about June 1, and all construction will be completed by July 1.

Directors of the airport company include John Murchison, W. T. Overton, Toddie Lee Wynne, Jr., W. D. De Sanders and James I. De Loache. The group is currently selling a $300,000 issue of convertible debentures to cover part of the $1,291,000 cost.

A survey of the Dallas area shows a total of 873 active non-airline aircraft.

A major selling point for the new field in the view of the airport's management is that it is more convenient to north Dallas than Red Bird Airport, the municipal airfield for executive use located in the southwest part of Dallas. A company survey shows that the majority of executive aircraft users live in north Dallas.

Present construction plans include a 4,500 ft. hard surface runway designed to handle aircraft up to a Convair Liner. Within five years the runway will be extended another 1,000 ft. The airport also will have a system of hard surface taxiways and parking ramps. A 3,200 ft. turf strip will provide a second runway.

The $50,000 terminal building measuring 45 x 106 ft. will include a ready room, offices, lounges, and a restaurant.

Terminal will have two-way radio communications with the airport's fuel trucks.

A terminal VOR will provide assistance in approaches at Addison, and in a year or so, when aircraft movements reach 2,000 a month, a control tower will be built.

Aircraft servicing will be handled by Dal-Tex Aviation, local Cessna dealer, which will have its own hangar and showroom. Associated Radio Corp. will

Revised Howard Has 150 Mph. TAS

Modified Howard DGA 15P floatplanes have metallized fuselage, extra cargo door and seating capacity increased to six. True airspeed of 150 mph is claimed by modification firm Jobmaster Co., Seattle, Wash., using 70% power at 7,000 ft. Package plans for reworking standard airplanes runs from less than $20,000 to over $25,000

have a similar facility for radio work.

Collins Radio Co. and Delhi-Taylor Oil Company have each contracted for separate hangars for their executive flight operations. Murchison Brothers and Union Chemical and Materials Corp. will also use the Delhi-Taylor facility.

Collins and Delhi-Taylor hangars will be cantilevered structures providing a 120 x 160 ft. open area which will be 30 ft. high. At the rear of each hangar is a 40 x 160-ft. two-story area for shops, storage and office space. Addison Airport also will have 150 T hangars.

Industrial Exhibits Aid Airplane Sales

Proof that industrial trade shows are a major source of business aircraft sales contacts is provided in Beech Aircraft Corp.'s recent experience with its exhibit at the American Road Builders Assn. show in Chicago.

Three aircraft cabin mockups and a full size complete Beech Bonanza, plus a styling display, highlighted the company's floor exhibit at the International Amphitheatre. A 35 ft. semi-trailer and a 1½ ton truck moved the major portion of the display, the Bonanza being flown to Chicago, where it was disassembled, taken to the Amphitheatre and reassembled. Ten Beech personnel, including distributor people, manned the display, surrounded by exhibits of light and heavy earth moving and construction equipment.

Their comment: "We feel that our participation was extremely worthwhile." Of the approximately 50,000 people attending the ARBA show, the majority visited the Beech display and its representatives obtained the names

of several hundred good prospects, and actually talked to several thousand visitors.

Since the construction and petroleum industries are two major business plane markets, Beech plans further participation in their major shows. It was the first time the company had set up a display at a roadbuilder's show; it had previously been represented at the International Petroleum Exposition at Tulsa, Okla. held every four years. A Beech spokesman states that in all probability the company will cover both shows in the future.

PRIVATE LINES

Colonial Skimmer amphibian number 18 has been delivered to Surinam Timber Development Co., Dutch Guiana, for business flying operation.

Republic Steel Corp., ordered its second Howard Super Ventura executive transport, the 21st of the type sold by the San Antonio, Tex. conversion firm. Republic Steel's second plane will have weather radar, Sperry A-12 auto pilot and Bendix and Collins navigation and communications gear.

Cash prize of $300 plus a trophy will be given for best antique airplane flown in to Reading Aviation Service's eighth annual maintenance and operations meeting, Reading, Pa., Municipal Airport, June 1. Cash prizes and awards will also be given to best-in-class current business planes to attend the meeting.

First Edgar Percival EP 9 agricultural airplane sold in Europe has been ordered by Ernest Ludt K. G., Hartenholm, Germany, which will use it primarily for spraying fruit crops.

Soviet-designed STOL, engineered by Oleg Antonov, is reported to be capable of taking off from and landing on unprepared strips of 200-ft. length, has a speed range of 21.7 mph. to 124.2 mph. Named the "Bee", the new Antonov STOL is especially designed for novice pilots.

Tally to March 8th of Bell Model 47 helicopter production since it received CAA type certification 11 years ago shows that the company has turned out 1,804 of the rotary wing aircraft as of that date, with 1,082 going to military services. Of the total 382 were manufactured in Buffalo, N. Y., 1,422 were built in Bell Helicopter Corp.'s Ft. Worth, Tex., plant.

Aircraft sales and brokerage firm, covering leasing and financing, has been formed by Gordon D. Brown at 521 Fifth Ave., New York 17, N. Y.

German Design Mounts Propeller in Tail

Bonn, Germany—Novel two-place power glider/private plane designed to sell for $5,000-$6,000 has been successfully flight tested by Rhein-West Flug Fischer & Co., Prinz Westhofen. Several models, with various power plants including a light gas turbine, are projected. Initial production plans call for output of 50 aircraft, most of which have been sold, the maker reports.

Outstanding feature of the RW-3 is tail mounting of its Porsche engine, which drives a pusher propeller located in a gap in the fin. Purpose of this novel installation is to reduce turbulence associated with a normal nose-mounted propeller. Enhanced visibility from the cockpit is another feature. When the RW-3 is used for gliding, the propeller is rotated to a vertical position in the fin slot, reducing drag.

Flug Fischer plan to offer two models of the RW-3:

- **A-2** with wingspan of 49.2 ft. powered by a 65 hp. or 100 hp. Porsche, with range of 560 mi. and 345 mi. respectively. Sea level cruise speed would be 123 mph. with 65 hp., 143 with 100 hp. Fuel capacity is 15.8 gal.
- **A-3** with 32.8 ft. span with range of 1,180 mi. with 65 hp. and 890 mi. with 100 hp. Sea level cruise speeds are estimated at 124 mph. and 144 mph. respectively. Additional range is possible because of installation of tip tanks of 15.8 gal. capacity each replacing the deleted wingtip sections.

Porsche is currently developing a 130-hp. engine which Flug Fischer will test in the RW-3. Another project calls for installation of a gas turbine of approximately 550-lb. thrust.

Basic construction comprises welded steel fuselage, plastic covered. Wings are single-spar mahogany, with metal spars. Seating is tandem with dual controls, the rear seat slightly above front position, both occupants viewing one instrument panel up front.

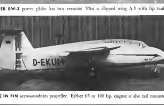
Landing gear is retractable tricycle, mechanically operated by a hand lever. Main wheels are fitted with independent brakes.

Skids under the fuselage are provided to take shock of emergency wheels-up landings.

The RW-3 A-2 is designed for a glide ratio of 1:22. Having a powerplant is of considerable assistance in gliding work, since it obviates need for launching gear or a tow plane, although it does compromise optimum glider performance to some extent.

Builder estimates that the RW-3 with a 65 hp. Porsche will cost just under $4 per hour to operate on the basis of 1,000 hr. annually.

FISCHER RW-3 power glider has two versions. This is clipped wing A-3 with tip tanks.

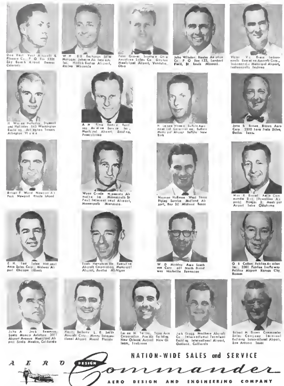


SPACE IN FIN accommodates propeller. Either 65 or 100 hp. engine is also tail mounted.

Fischer RW-3

	RW-3 A-2		RW-3 A-3	
Powerplant (Porsche)	65 hp	100 hp	65 hp	100 hp
Span	49.2 ft	49.2 ft	32.8 ft	32.8 ft
Length	24.3 ft	24.3 ft	24.3 ft	24.3 ft
Height	6.9 ft	6.9 ft	6.9 ft	6.9 ft
Fuel capacity	15.8 gal	15.8 gal	15.8 gal	15.8 gal
Empty weight	982 lb	982 lb	949 lb	949 lb
Maximum gross weight	1,434 lb	1,434 lb	1,434 lb	1,434 lb
Takeoff run[1]	528 ft	381 ft	645 ft	482 ft
Takeoff run[2]	855 ft	550 ft	855 ft	728 ft
Takeoff speed[1]	39.2 mph	39.2 mph	48.6 mph	48.6 mph
Rate of climb[1]	668 fpm	1,200 fpm	590 fpm	1,100 fpm
Maximum speed (sea level)	130 mph	150 mph	132 mph	153 mph
Cruise speed (sea level)	123 mph	143 mph	124 mph	144 mph
Service ceiling	over 13,000 ft		over 13,000 ft	
Lift/drag ratio	28	26	18	18
Fuel consumption	3.1 gph	4.4 gph	3.1 gph	4.4 gph
Maximum range	580 mi	345 mi	1,180 mi	892 mi
Landing speed[1]	39.2 mph	39.2 mph	48.6 mph	48.6 mph

[1] Gross weight, wing tanks full, with pilot only. [2] Maximum gross weight.



USAF Contracts

Following is a list of unclassified contracts for $25 000 and over as released by Air Force Contracting Offices

AMC WRIGHT-PATTERSON AIR FORCE BASE Ohio

AVCO Manufacturing Corp Lycoming Div 550 Main St Stratford Conn. R1800-JA engines Air 0631 (PR 70946a 706870 609626) $1 695 019

Continental Aviation & Engineering Corp. 12700 Kercheval Ave. Detroit, Mich. YJ69 T-17 engines A1J3408 (PR 655046 07 B-11Q) $255 704

Motorola Inc., 2710 No Clybourn Ave. Chicago 14 Ill indicator azimuth & range IP 284/APS 109 ea synchronizer SN-153/APS-64 58 ea position mark generator AN/AWA-2 21 ea (PR 709516 426316 711677 704619 706139) $1 249 078

AiResearch Manufacturing Co of Arizona, Div Garrett Corp Sky Harbor Airport 402 So 36th St Phoenix Ariz. GTC85-52 gas turbine compressor (installations) (spares) (training command) 141 ea., (PR 11 63e614Q) $2 033 918

Sundstrand Machine Tool Co., Sundstrand Aviation Div Rockford, Ill. transmission and governor assemblies (B-47 aircraft) (PR PE 639738Q) $1 541 736

Curtiss Wright Corp Wood Ridge N J Curtiss Wright Propeller Div Caldwell N J synchronizer assembly 219 ea., (PR (WR) 408,4 -2) $903 527

Minneapolis-Honeywell Regulator Co. 2700 Ridgway Rd Minneapolis Minn components of type MB 1 automatic pilot system spare parts, special tools and data F-101A aircraft (PR 709760 Amendments 1 and 2) $4 393 473

Minneapolis Honeywell Regulator Co. 2700 Ridgway Rd Minneapolis Minn., components of type MA 4 automatic pilot system spare parts, special tools and data, B/RB 66 aircraft (PR 705794 & Amendments 1 and 2) $983 968

The W L Maxson Corp 460 West 34th St New York 1 N Y amplifier assemblies P/N R-55068 K-4 computer 46 ea computer assemblies, P/N R-57095 K-4 computer 48 ea alt. vne trans P/N B 54100 K 4 computer 48 ea (PR 4080 -2) $828 703

Weston Electrical Instrument Corp 614 Frelinghuysen Ave Newark 5 N J. indicator ID-552A/ARN or ID 387/ARN 2 91 ea., (PR PE 226938 MA 696609 SM 577251 OC-661951 MIPR R-56 147 30-AER Amendment 1 R-56-842-169-AER) $1 290 811

Kollsman Instrument Corp 80 08 45th Ave Elmhurst N Y compasses astro automatic type MD 1 42 ea spares assemblies spare parts (RFP PE 670619), $1-623 566

General Electric Co. 606 Main St Johnson City N Y components and spare parts for C 4 C-4 A-6 MD 4 MD 1A & MD 1 fire control systems (PR WR 473615 -1 WR428628 -1 WR427598 2 -3 4 and 718279) $622 123

The George W Borg Corp Borg Div 120 So Main St Janesville Wis loop assembly AS 313B/ARN-6 part of ARN-6 radio compass, a navigational aid used in practically all USAF aircraft antenna cover for above item spare parts and data for above items (PR 670738 MIPR R02-693171 SC-01-21 and Amendments 1 and 2 MIPR R56 841 199 Aer) $471 884

Lear Inc 110 Ionia Ave NW Grand Rapids Mich indicator attitude remote type MM-2 3 518 ea control roll and pitch type K-4B 2 036 ea (PR SM537235 PE670653 PE670654 MIPR R56-1324-229-AFT) $4 250 400

Sperry Gyroscope Co 2328 Broadway Santa Monica Calif indicator attitude remote type MM-2 1 347 ea control roll and pitch type K 4B 1 358 ea (PR SM53 7245 PE670653 PE670654 MIPR R56 1324-226 Aer) $2 731 811

AiResearch Manufacturing Co of Arizona 402 So 36th St Phoenix, Ariz., starters pneumatic type MB 3 335 ea. (PR 671981 and -1) $643 915

Solar Aircraft Co San Diego Calif. gas turbine generator set type MA 1 model

f 41M ... ea data (PR OC-666539Q) $2,049,273

AiResearch Manufacturing Co. Division of The Garrett Corp. 9851 Sepulveda Blvd., Los Angeles 13, Calif. drive assemblies constant speed pneumatic type MC-1 40 ea. (PR TE6943581) $729,000

Summers Gyroscope Co. 2500 Broadway, Santa Monica, Calif. indicator direction gyroscope type ... 1467 ea. (PR PF670-6? MA718013 MA718014 OC70s35s and OC70s3681) $1,856,240

Kearfott Co. Inc. 1150 McBride Ave., Little Falls, N. J. indicator master 961 ea. directional control 204 ea. control slaving 218 ea. (PR 635957) $2,356,241

Kearfott Co. Inc. 1150 McBride Ave., Little Falls, N. J. amplifiers servo component of J-4 compass 726 ea. control directional component of J-4 compass 734 ea. panel control component of J-4 compass 558 ea. (BPP 635958) $1,808,08.

General Electric Co. Lynn, Mass. acquisition manufacture installation and rehabilitation of facilities (PR 678036) $2,516,326

North American Aviation, Inc., Air Force Plant ... Installation #42 Palmdale, Calif. additional flight test facilities in support of F-100 aircraft production (PR 601778) $ ...

Republic Aviation Corp., Farmingdale, L. I., N. Y. modification of F/RF-84F ... trainer units and procurement of additional trainers (PR 636003) $457,568

Air Products Inc., Allentown, Pa. facilities for the production of liquid oxygen (PR 18065-1) $2,703,000

Otis Elevator Co., Electronic Div. ... Stevenson St. Brooklyn 5, N. Y. AN/APA-1?? interconnecting groups maintenance spare parts engineering data revisions to maintenance data etc. (PR PH671164) $308,187

The O. A. Sutton Corp., 1812 W. Second St. Wichita, Kan. jettisonable fuel tanks for F-84F and F-102 aircraft (first articles) (PR 672-19) $411,610

Mar-Pak Corp., 1560 W. Jackson St., Painesville, Ohio reclamation and demilitarization of type B-36 aircraft, (PR 641677, 641677-1, 647677-2) $478,734

Continental Aviation & Engineering Corp. Detroit, Mich. acquisition supply design manufacture construction rehabilitation and installation of facilities for the production of gas turbine compressors (PR 673-8?-1) $1,500,000

Canadian Commercial Corp. Washington, D. C. L-20A airplanes and related supplies for the Dept. of the Army 1 L-20A airplane for MDAP (MPR R-56-610-TC R-56-619-TC) $2,169,013

General Dynamics Corp., Convair Div. Air Force Plant #4 Fort Worth, Tex. additional facilities for B-58 program (PR 701121) $308,000

Falun Manufacturing Co., Aircraft Div. Battle Creek, Mich. acquisition rehabilitation and installation of machinery and equipment for the production of blades. (PR 183779) $1,500,000

Douglas Aircraft Co., Inc., Tulsa, Okla. facilities in support of C-132 (PR 560044) $ 74,100

Boeing Airplane Co., Wichita, Kan. facilities for B-52 aircraft production. (PR 701118) $915,000

Pacific Airmotive Corp., 2940 N. Hollywood Way, Burbank, Calif. IRAN maintenance F-86A/F and F-86F type acft. (PR SM-536825, SM-536835-1 and SM-536830) $750,000

Hayes Aircraft Corp. Birmingham, Ala. IRAN of B-50 acft. and modification of B-50 acft. to the KB-50 configuration (PR 732805) $711,006

Temco Aircraft Corp., Greenville, Tex. IRAN maintenance fuel tank deseal and reseal and electronic modification of C-54 acft. (PR SB-664258) $2,037,875

Hayes Aircraft Corp. P. O. Box 2287, Birmingham, Ala. IRAN and modification of RB/TB/WB/B-50 acft. (PR OC-708701 and DL-666272) $466,000

Collins Radio Co., Inc. Cedar Rapids, Iowa vertical gyro course indicator steering computer with shock mount F162B C-130A components (PR 708087 and 708-057-11) $1,249,108

Kaiser Aluminum and Chemical Corp. P. O. Box 749, Newark, Ohio for operation

and maintenance of USAFDIER storage site No. 4 Newark Ohio (PR 143225 and 150752) $443,469

The Bendix Corp. Santa Monica Calif, facilities for air defense system training program (PR 671170) $253,300

Thompson Prod Inc Cleveland Ohio, acquisition rehabilitation and installation of facilities for J 79 engine program (PR 773139) $6,800,000

Air Products Inc Emmaus, Pa facilities for the production of liquid oxygen, (PR 070103) $2,910,000

The Tempoor Co, Inc USAFDIER Storage Site 7 Terre Haute Ind. services maintenance and operation of war reserve machine tool storage site (PR 143203 PR-143203-1 703270 and 709257) $756,098

The Tempoor Co Inc., USAFDIER Storage Site 3 Marietta Ga., services maintenance and operation of machine tool storage site (PR 113215 and 180747) $1,942,514

William J Graham & Son (dba) Graham Aviation Edward Gary Air Field San Marcos Tex operation of an Army fixed-wing primary pilot training program (PR 009910) $394,869

Pacific Airmotive Corp 2940 N Hollywood Way Burbank Calif IRAN reconditioning modification and flight test of C 47/C-117 type acft (PR SB-524269) $5,494,250

Butler Mfg Co 7100 E 13th St Kansas City 26 Mo first article type L-8 oil serv truck spare parts, maintenance tools (PR MP-568674-1 and -2 MP-568105 and -1) $1,869,591

Utica-Bend Corp., 38600 Mound Rd Utica Mich overhaul of J 47 GE 25/27 A type a/c engines (PR OC 720320) $3,632,500

Lockheed Aircraft Corp., Burbank Calif., reconnaissance supporting system for SAC and TAC project Monticello I (PR PM-13933) $1,849,490

Southwest Airmotive Co, Love Field Dallas Texas overhaul J33-A35 A/C engines (PR OC-732757) $1,383,849

Aircraft Engineering and Maintenance Co Municipal Airport Oakland Calif IRAN maintenance and modification of F-86 type aircraft (PR SM-526840) $750,080

AVCO Manufacturing Corp Crosley Div Cincinnati 15 Ohio fire control systems bomber flexible tail defense type MD-9 for B 52 (PR 709835 709835-1 709807 709807-1 709797 709797-1 708898) (PR 709895 709835-1 709867 709807-2 709797 709797-1 709868 709852 218589 and 218589-1) $25,150,518

Hillion Brothers, Inc 1815 Venice Blvd Los Angeles Calif 9480 5487 2 and 3 actuator 340 ea maintenance data (Pr SA-723388 Q) $84,203

General Precision Laboratory, Inc 63 Bedford Rd Pleasantville N Y amplifier electronic control AM-016/APN-89 84 ea. (PR PE 079793) $323,754

Safe Flight Instrument Co. 1 Water St White Plains N Y 3481 22800 vibrators non synchronous 1,664 ea. (PR SA-723383 and 1Q) $118,302

Bendix Aviation Corp., Bendix Products Div 401 Bendix Drive South Bend 20 Ind wheel assy A1W-1012 92 ea., brake assy A1V-1107 165 ea. (PR PE-071353 and PE 540240) $203,629

Lockheed Aircraft Corp. Marietta Ga. additional funding action for modernization of C 130A airplanes (PR PR-285029) $265,000

Boeing Airplane Co, Seattle Wash modification of C 97-4 and C-97-5 mobile training units (PR PH-221648 and PH-221700) $377,954

Allison Div, General Motors Corp P O Box 894 Indianapolis 6 Ind services and supplies necessary to modify and convert 133 A 33/33A engines to the following 121 A 37 turbo-jet aircraft engines (TM 61A missile) and 133 A 41 turbo-jet aircraft engines (TM 61B missile) (PR 672907, 672875 and 672808) $2,446,666

General Electric Co French Rd Utica N Y spare components for APG-41B radar set (PR WR 407004 WR-407004-1 WR-427590 WR-427526-2) $139,268

Sperry-Rand Corp Sperry Gyroscope Co Marcus and Lakeville Rd Great Neck N Y components for E-4 autopilot to be

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

The bright-red Hellcat drone clattered across the sky, a World War II veteran sentenced to die for the proof of technology.

Far aft, an F3H Demon broke out of the overcast in a shallow dive and headed for its fleeing quarry.

The shrill-whining Demon closed rapidly to three thousand yards, then a sliver of fire detached itself from the jet and streaked for the Hellcat at supersonic speed.

A burst of orange flame marked the perfect hit that blew the tail completely off the target plane. The Hellcat staggered on for a second or two amidst a shower of its own debris before falling off into a flat spin that steepened to explosive impact on the desert floor.

The Navy's Sidewinder guided missile had proved its venom in first public demonstration.

Had the target been an enemy jet at high altitude the result would have been the same for the blunt-nosed Sidewinder follows its prey tenaciously despite evasive maneuvers and strikes with the viciousness of the desert rattle snake for which it is named.

A long, slender missile measuring 9 feet 5 inches and weighing some 155 pounds the Sidewinder was developed from drawing board to acceptance trials by the Naval Ordnance Test Station, China Lake, Calif — the first operational weapon of its type ever achieved by a government laboratory.

And credited with its success is a quiet, almost shy, bespectacled scientist Dr William B McLean, station technical director, who pushed and pulled the missile through years of development starting in 1951 and received the nation's highest Civil Service incentive award of $25,000 for his role in the project.

Bill's design philosophy integrated three basic principles throughout the development. The Sidewinder must be accurate and highly reliable, he decreed. It must be simplified for producibility and cost reduction and as a new weapon system it must meet the specific needs of the fleet.

All three goals were achieved in the missile and one reason for its success was the Navy's willingness to concentrate all technical responsibility and authority in the staff of the Naval Ordnance Test Station.

Its accuracy and reliability have been proved. On one of its early test shots it brought down a B 17 drone even without a warhead. Later its sharp shooting characteristics were further defined when it knocked off a Matador missile, according to reports.

The weapon's simplification is shown by the fact that it has few moving parts and contains little more electronics than the average radio. These features have brought its cost down to a current $1600 per copy, I hear, and this figure probably can be halved when it reaches mass production.

Furthermore — although no weapon system is universal — it meets a particular tactical need without making any real sacrifice in over all tactical usefulness.

The death of the Hellcat was awesome in the inexorable manner of an execution.

Even before the missile was launched the seeking eye in its nose was buzzing — rattlesnake like — as it caught and held the infrared rays emitted by flares on the drone which simulated jet exhaust.

At the instant of launch the seeker was transmitting flight intelligence to canard control surfaces on the Sidewinder's nose section then followed through with minute changes in course as the missile flashed toward its target at better than twice the speed of sound.

Its streaking flight lasted no more than a few heartbeats — a distant toothpick pushed by a thin stream of fire from its solid propellant motor. Then it rammed the drone with terrific impact that detonated an estimated five pounds of high explosive in its warhead. A blast of flame and flying chunks marked the Hellcat's death throes. It was all over but the spin and the blazing finale.

It could have been fired at high altitude at an enemy jet bomber. It could have executed 10 to 14 G turns to cut off and intercept an evasive target. It could have scored a kill and perhaps prevented an atomic holocaust.

used for C-118 C 74 C 118B type aircraft for spares. (PR MA-677291) $538 946

Curtiss-Wright Corp Propeller Div Caldwell N J propeller assemblies (Inst) and (spares) controls all for support of ZS2G-1 airships (MIPR R56-1059-144 and Amendment 1) $583 282

Bendix Aviation Corp Red Bank Div Eatontown N J generators, 10 KVA A C regulators voltage panels control A C for F101A aircraft (PR PE-624310) $1 137 791

Boeing Airplane Co., Seattle Wash facilities for the production flight testing of B 52 aircraft. (PR 630769) $4 766 609

Fritz J Russ /DBA/ Systems Research Laboratories 300 Woods Dr Dayton 3 Ohio maintenance and operation of OARAC and operation only of ERA 1103 computers at Building 57 WADC Wright Patterson AFB Ohio (PR 2286) $135 399

Bill Jack Scientific Instrument Co. Solana Beach Calif D-2 Chassis 113 ea D-2 Chassis 115 ea B 2 Mounting Base 314 ea (PRs 564633 564633 561627 564627 564631 584634 MO 671433 amend-1 564145 664 166 S/A 692k46) $375 963

The Goodyear Tire and Rubber Co. Inc. 1144 East Market St Akron 16 Ohio Wheel Assembly 26x6 Brake Assembly (for 26x6 Wheel) Brake Assembly (for 26x6 0 For T-33A Aircraft) (PR PE 564240 1) $767 166

Airesearch Manufacturing Co of Arizona Div of the Garrett Corporation Phoenix Ariz. Starters pneumatic aircraft Engine LYER no 2-6317 (PR PL-6706971 $674 456

RCA Paint and Cooper Sts., Camden 2 N J Receiver-Transmitter RT 128A/ARC 21 551 ea Control Panel C-461A ARC-21 406 ea Power Supply PP-268/ARC-21X 435 ea (PR PE-670660 and 570630) $7-266 912

Boeing Airplane Co Seattle Wash KC-135A Fuselage (PR PH-673069) $866 231

Boeing Airplane Company Wichita Kans, Modification of mechanical and electrical B 47 MTU's together with training transparencies (PR PH-269373) $166 066

Boeing Airplane Co. Seattle Wash Model KC-135A Airplane designed and fabricated in accordance with contractor's model (Spec D-15441 PR PH209871) $50 060 066

Sikorsky Aircraft United Aircraft Corp Stratford Conn H-19D Air Force Helicopters with Spare GHE and Data (PR 709584 and 709521) $97 060

Helicopter Division of Bell Aircraft Corp Fort Worth Texas XH-40 Helicopters spare parts ground support equipment data and so forth (MIPR R-56-691-TC) $1 560 866

General Electric Company Syracuse N Y Facilities to support of the WS-107A Program (PR 630774) $800 815

AC Spark Plug Div General Motors Corp Milwaukee Wis Facilities in support of the WS-315A Program (PR 65 108) $2 064 934

Aerojet General Corp Sacramento Calif Facilities for the support of the WS 107A Program (PR 630528 and 604354) $10-568 486

American Bosch Arma Corp Garden City N Y Facilities for the support of the WS-107A Program (PR 701141 $17 600

Thompson Products Inc Cleveland Ohio Preparing facilities for shipment (PR 630773) $640 006

Dow Chemical Company Midland Mich Additional facilities for the production of aircraft extrusions, (PR 630758) $175 000

AF OFFICE OF SCIENTIFIC RESEARCH ARDC Washington 25 D C

Fairchild Engine Div of Fairchild Engine & Airplane Corp Deer Park L I N Y research in supersonic combustion (AF 49 (638)-15) job $206 360

Cornell Aeronautical Laboratory Inc 1455 Genesee St Buffalo 21 N Y research on Hypersonic Research Apparatus (AF 18(603)-111) job $1,496 644

AIR FORCE MISSILE TEST CENTER, Patrick AFB (ARDC) Fla

General Dynamics Corp, (Convair Div,) San Diego Calif Design Development and Fabrication of Azusa Tracking Equipment Operational Model (Mark II) (PR RF-1 (56) 243 & RF-1(56)-276) job $2 495 063

Collins Radio Company 855 45th St N W Cedar Rapids Iowa 10 KW UHG Command

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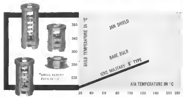

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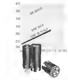

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Control An[illegible] Job $176 86

Radiation, Inc PO Drawer 37 Melbourne Fla Five automatic tracking telemetry antennas (PR FP-1156-440) Job $1 414 726

The Perkin-Elmer Corp Norwalk Conn Recording Optical Tracking Instrumentation Systems and Installation (PR FP-11 61 281 & PR FP 11561-364) Job $1 128 091

Reeves Instrument Corp 215 East 91st St N Y 28 N Y AFMTC Model II Radars Shelters Services and Instruction Manuals (PR FP 11561 380) Job $1 040 167

ROME AIR FORCE DEPOT, Griffiss Air Force Base N Y July 24

General Electric Co Electronics Park Syracuse N Y de-multiplexer group OA 979/GKA-4 74 ea. flight control group AN/GKA 4 7 ea. de-multiplexer test signal generator 40 ea (RFP 30 635 56-4639Q) $ 989 941

Lewyt Manufacturing Corp. 43 22 Queens St Long Island City N Y coordinate data monitor OA 947/FST-4 (PR 681671) 78 ea $812 301

Hazeltine Electronics Corp 59 25 Little Neck Parkway Little Neck 62 L I N Y indicator group AN/UPA 36 (RFQ 30 635 56 4730Q) $4 322,563

Northern Radio Co Inc 149 W 22nd St N Y 11 N Y Frequency shift diversity converter 18 ea (RFP 30 635 56 4027Q) $297 397

Northeastern Engineering Inc, 25 S Bedford St Manchester N H 992 11 Crypt terminal rack 1443 ea (IFB 30 625 56 915B) $443 450

Wilcox Electric Co Inc 1400 Chestnut St Kansas City 27 Mo Wilcox type 482A TVOR 13 ea (RFP 30 635 56-4614Q) $285-605

Salyers Equipment So 128 East Washington Blvd Los Angeles Cal Generator set diesel engine trailer mounted for radar sets AN/MPN 11 (RFP 30-635-56 5064Q) $1-158 910

Philco Corporation 4700 Wissahickon Ave Philadelphia Pa CLR 6 and CLR-7 Microwave equipment (RFP 30 635 56 461-5Q) $907 189

Firestone Tire and Rubber Co of Canada 110 Burlington St East Hamilton Ontario Canada Radome CW-206C/CPS 6B (IFB 30 61 76 311B) 65 ea $692 960

Gilfillan Bros 1815 Venice Blvd Los Angeles Cal AN/MPN-11 radar set, (RFP 30 635 56 4569Q) $6 495 525

WARNER ROBINS AIR MATERIEL AREA, Robins AFB Ga

Hughes Aircraft Co Culver City Calif., Reflector 1 068 ea Receiver transmitter subassy 18 ea Wave guide assy 870 ea (IFB-390) $204 878

Hughes Aircraft Co., Culver City Light filter assy 1512 ea Synchro transformer 142 ea Gear assy 1450 ea applicable to FCS systems (IFB 428) $205 937

Hughes Aircraft Co Culver City Modification kits to rework FCS receiver-transmitter (PR 00 4438608 & 08 555214) 222 ea $171 003

Radio Corp of America Camden N J Waveguide elbow 4947 ea electric control assy 1335 ea antenna control 476 ea (IFB-428) $321 057

John Oster Mfg Co Racine Wis Motor AC 50/26F 400 cycle & pin 1626 ea motor AC shaded pole induction type 4621 ea applicable to A1A 28 radar set (IFB 411) $[illegible]

Servo Mechanisms Westbury N Y Repair/modification of Range Servo and Angle of Attack Computer components (PR-7140-49 and 544801) $309 239

AC Spark Plug Div GMC Milwaukee Wis Modification kits for K system BNC (PR 681208 and 70 other PR's) $936 146

AC Spark Plug Div GMC Milwaukee Wis Modification kits for A-1A BNC systems (PR 681223 and OC 691811) $421 781

General Electric Co, Johnson City N Y modification kits applicable to tail computers (PR 433561) $117 108

Sperry Gyroscope Co Great Neck N Y modification kits for transmitters, controls and converters $241 504

Curtiss-Wright Corp Caldwell N J repair modification repair and packaging

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rirrick propeller assys (PR-734570) $265-890

General Mills, Inc., 1620 Central Ave Minneapolis 13, Minn spare parts for Y-2 Y-1 and Y-4 periscopic bomb sights (IFB 1691 various quantities, $425 344

Western Electric Co., Winston Salem N C gear assy gear reduction assy gear reduction unit etc for AN/APA-44 series ground position indicators, (IFB 420) $143-268

Servomechanisms Inc Westbury N Y amplifier assys, angle of attack positioners mount assys, etc applicable to E series fire control systems (IFB-382) $261 887

A C Spark Plug Div., GMC Milwaukee, Wis., amplifier assemblies and other spare parts applicable to the A-1 and A-1A bombing navigational systems (IFB-398) various quantities $1 111 129

A C Spark Plug Div GMC Milwaukee Wis clutch assembly motor network and plate assembly etc for A-1 and A-1A bombing navigational systems (IFB-433) various quantities $1 197 268

MIDDLETOWN AIR MATERIEL AREA Procurement Div Olmsted AFB Pa

Bell Aircraft Corp Helicopter Div Ft Worth Texas IRAN of H-13 type aircraft PR MA-580307 38 ea $100 008

Canadian Commercial Corp Ottawa Province of Ontario Canada IRAN of type L-28 aircraft PR MA-650865 81 ea. $188 880

Fairchild Engine & Airplane Corp Fairchild Aircraft Div Hagerstown Md IRAN flight test & preparation for delivery of type C-123 aircraft 38 ea PR 701631 PR 701631-1 $817 000

Zenith Instrument Co Inc. 523 Forest Ave Paramus N J release assy parachute ripcord 5 000 ea IFB PR 882733, $104 822

Decker Aviation Corp 1361 Frankford Ave Philadelphia 25 Pa repair and modification of components of the type A 12D autopilot 1 400 ea $273 601

Vertol Aircraft Corp Morton Pa. services for the repair and/or overhaul of H-21 transmissions and rotor hub assemblies 943 ea $277 672

United Aircraft Corp Sikorsky Aircraft Div Stratford Conn. services and material necessary in repair and/or overhaul of H-5 H-18 and H-34 rotor blades 813 ea $347 928

Irving Air Chute Co Inc, 1315 Versailles Road, Lexington Ky parachute aircraft approach 2,000 ea, (RFP PR MA 584170 & 8104) $281 280

Weston Electrical Instrument Corp 614 Frelinghuysen Ave Newark 5 N J meters ruggedized electrical PR MA 718634 MA 718563 MA 718852 MA 718852-1 MA 718651 MA-718654, 8253 ea $215 014

OKLAHOMA CITY AIR MATERIEL AREA Tinker AFB Okla

Aldel Precision Products Division of General Metals Corp 10777 Vanowen St Burbank Calif valve assembly solenoid (RFP 57-031-1 OC-031180) 2 items $123 541

Fairchild Engine and Airplane Corp., Stratos Div Bay Shore Long Island N Y overhaul and modification of B 47 refrigeration units (OC-730188 OC-728189) job $707 448

Boeing Airplane Co Wichita Kans service and assistance to the Air Force in support of B-52 field modification (OC 729533) job $210 006

Boeing Airplane Co Wichita Kans service and assistance to the Air Force in support of B 52 field modification (OC-729533), job $216 000

Aviation Electronics Inc 1328 N Mosley Wichita 6 Kans. jet engine run-up control assy (IFB 34-601-470) 1 item $465 868

The Garrett Corp AiResearch Mfg Co of Arizona 402 S 36th St. Phoenix, Ariz. overhaul and repair of gas turbines (OC 723614 & C1) job, $275 471

MOBILE AMA Brookley AFB Ala

Lord Manufacturing Co Erie Pa fabrication of Lord core assemblies contract Nr AF 01(601)19985 Close 03-5 3 items 14430 ea. $114 819

M B Manufacturing Co 1060 State St.,

New Haven Conn refabrication of MB carr assemblies, Contract Nr AF 01(601)29020 Class 03-J 11 items 15450 ea $192 925

Republic Aviation Corp., Farmingdale L. I N Y modification of F 84F aircraft contract Nr AF 01(601)10860 Class 01-A 1 item 464 ea $36 777 817

Bendix Aviation Corp Utica Div Utica, N Y repair and modification Bendix 30E23 starters, contract Nr AF 01(601)19873 1 item 601 ea $34c 12o

OGDEN AMA Hill AFB, Utah

Curtiss Wright Corp 631 Central Ave Carlstadt N J., contractual maintenance of flight simulators, Class 20A, (PR 00-05837) $2 273 141

General Motors Corp., Allison Div Aero products Operations Municipal Airport Dayton 1 Ohio modification and overhaul of 900 model AAHL-A series actuators contractor furnished parts and rework of valve assemblies Class 01C (PR's 00 78056 and 00 78078 1) $385 200.

Navy Contracts

Following is a list of unclassified contracts of $25 000 and over as released by Navy Contracting Offices

AVIATION SUPPLY OFFICE, 700 Robbins Ave, Philadelphia 11 Pa

General Textile Mills Inc., 470 Seventh Ave, N Y 1 N Y helmets (383/2904e-6203/5/57) various $171 320

Columbus Div North American Aviation, Inc., 4300 E Fifth Ave Columbus 16 Ohio ground handling equipment for AJ acft. (383/2110-3709/52) various $338 810

Eclipse-Pioneer Div Bendix Aviation Corp. Teterboro N J instruments (383/2120-1988/3/52 383/2110 2132/52 383/2084 57/58) various $606 634

McDonnell Aircraft Corp P O Box 516 St Louis 3 Mo ground handling equipment for F3H aircraft (383/2110 19133/3/51 383/20869-75 83/1/571 various $213 004

Holley Carburetor Co., 11955 E Nine Mile Road Van Dyke Mich maintenance parts (381/2119-1347/51) various $796 071

Red Bank Div Bendix Aviation Corp Eatontown N J generators and relays (383/2140-482/54) various $884 284

B F Goodrich Tire & Equipment Co A Division of the B F Goodrich Co 500 South Main St Akron 18 Ohio deicer boots (383/2110-993/53) various $340 653

Bendix Products Div Bendix Aviation Corp. 401 Bendix Dr South Bend 20 Ind bellows assys valve assys (383/2117 380/521 various $171 14-

Northeastern Engineering Inc 3 Bradford St Manchester N H frequency meters (PD 383 2144 59) various $337 488

Scintilla Div Bendix Aviation Corp Sherman Ave Sidney N Y distributors coils magneto assys (383/2112 436/52 383/2167 1911/52) various $197 615

Seymour Wallas & Co 1205 S 9th St St Louis 4 Mo anti-blackout units (IPD-383-461 57) $600 311

Aeroquip Corp 300 S East Ave Jackson Mich fitting ends (IPD 383-919-57) 044 764

Pioneer Central Div Bendix Aviation Corp Davenport Iowa maintenance parts for regulator assys (383/2110-0881/52/1/s) Aero) $19 802

McDonnell Aircraft Corp P O Box 516 St Louis 3 Mo windshield assys (381/2110 1340/53) $209 304

Gould-National Batteries Inc., 35 Niagara St Depew N Y batteries (383/2140-1433-E 6/1/531 4 577 ea $233 714

McDonnell Aircraft Corp P O Box 516 St Louis 3 Mo circuits & flap assys (383/2110 1242/53 383/2110-2026/52 383/2110 1240/53) various $183 836

Wm R Whittaker Co Ltd 915 N Citrus Ave Los Angeles 38 Calif solenoids body assys (383/2110 124/55) various $91 374

Columbus Division North American Aviation Inc Columbus 16 Ohio pilot seats 1383/2110 1050/53) various $31 8--

Eclipse-Pioneer Div Bendix Aviation Corp Teterboro N J indicators (383/2110-2108/51 383/2120 66 4 4/3/52 383/2120 769/52), various $1 240 427

Rollsman Instr Corp 30 08 45th Ave, Elmhurst, N Y altimeters (PREN11-1250/571 various $283 803

NAVY DEPT Bureau of Aeronautics, Washington 25 D C

Motorola Inc., 4545 W Augusta Blvd Chicago 51 Ill. retrofit kits for AN/APS-31 and -32 radar sets NOas 56 092-f(PD-36-694-56) 698 $693 589

Packard-Bell Co 12333 W Olympic Blvd Los Angeles 64 Calif., RT 261/APX 7 radar recognition sets, NOas 56-997-1(PD 31-771-56) 176 $394 852

Master Specialties Co 950 E 108th St Los Angeles 59 Calif automatic parachute pack openers NOas 57 739 f(AE 52-1890-57) 1008 $124 292

Westinghouse Electric Corp. 1625 K Street N W Washington 6 D C Modification and overhaul of government-owned J46-WE-8A turbo jet engines to the J46 WE-8B configuration NOas 56 577-f(MA-44-e016-56), 39 $456 3e3

Hazeltine Electronics Corp. 5825 Little Neck Parkway Little Neck 62 Long Island New York AN/APS-20E radar sets NOas e6-833-f(PD31821-56 and 787 56) 128 $3 240 5e7

The Garrett Corp (Airesearch Mfg Co of Arizona Div.) Sky Harbor Airport, 40 South 36th St Phoenix Ariz. Gas turbine compressors model GTC 85-24 NOas 5- 846 f(PD 41 1949-56) 609 $8 303 171

Medeco Metal Castle Co, N E Corner York and American Sts. Philadelphia 33 Pa. Arco 38 explosive bolt pylons and explosive bolts NOas 56-842 c (AE 47 4135-56), 1 200 $135 641

General Development Corp., Elkton Md Construct test and furnish experimental dacron envelope for NSJG 1 airship NOas 56-000-f(AC 71-3704-58) 1 $395 622

Bulova Instrument Corp., College Point N Y Bombing data computer CP68A/AE 1 NOas 56-023-4(AE-7-4236-56) 30 $3 838 362

Boeing Airplane Co., Seattle 14 Wash., completion of r0 hr flight rating te

Prepare and furnish twenty (20) copies of a model specification for the Y160 BO-2 (Boeing model 520-2) engine. Design fabrication parts and test as required to demonstrate satisfactory XT60 Bo 2 engines. NOas 56 1063 c (FP 93-2163 56) $354 443

Boeing Airplane Co., Seattle Wash. Boeing model 502 11E gas turbine driven air compressor completely self contained on a four wheel towable cart trailer. NOas 56-1969-c (MA-46 5312-56) 20 $584 724

Norden-Ketay Corp., Milford Conn. bombing data computer CP64A/ASB-1 NOas 56-924 f (AR-74236 56) 18 $2,671 176

Irving Air Chute Co., Inc., 1315 Versailles Rd Lexington Ky automatic parachute opening devices. NOas 57-210-f (MA-30-0776-57) $336 935

Lockheed Acft. Service, Inc., P O Box 33 Ontario Calif services and materials for progressive maintenance of R7V-1 acft. NOas 57-276-c (MA-44-4379-57) $1 677 631

Stanford Research Institute, Menlo Park Calif study of changing structural design of combat aircraft. NOas 57 101-c (1P-31-4861-57) Jch $202 900

Temco Aircraft Corp., P O Box 6191 Dallas 2 Texas acquisition rehabilitation & installation of machine tools and equipment. NOas 57-041-c (1P-31 4558 57) $587 537

Goodyear Aircraft Corp., Akron 15 Ohio. services and materials necessary to furnish general airship indoctrination and systems maintenance training courses. NOas 57-310-1 (IFB-MA 303893 57) $100 847

Bell Aircraft Corp., Fort Worth, Texas. helicopters Model HTL 7 spare parts and special support equipment. NOas 57-158. $1 950,916

Stewart-Warner Corp., (Stewart Warner Elec. Div.) 1306 N Kostner Ave Chicago 51 Ill. sixty (60) men-months of field engineering services, altering repairing or operating and giving assistance in instructions on aircraft electrical & electronic equipment. NOa 57-249-s (IFB MA 3746-57) $72 336

Electrol Inc., Kingston N Y materials and service necessary to replace government-owned machine tools. NOas 57-020 c (IFB 31-4913-57) $260 990

McDonnell Aircraft Corp., P O Box 516 St Louis 3 Mo preparation of facilities for shipment. NOas 57 004-c (IFB 1P 12-487-57) $30 060

Librascope Inc., 808 Western Ave Glendale 1 Calif modification of CP-206 (XN-2) (ASB computer. NOas 57 411 c) (IFB AV 32 1568 57) $140 736

Bendix Aviation Corp., Eclipse-Pioneer Div Teterboro N J preparation of facilities for shipment. NOas 57 019-c (IFB 1P 4-4859 57) $23,560.

RCA Service Co. Inc., Camden N J field engineering services in the maintenance repair and operation of aircraft electrical and electronic equipment. NOas 57-236 s (IFB MA 30-3758-57) $1 031 849

NAVY DEPT. BUREAU OF ORDNANCE, Washington D C

Hycon Mfg Co., Pasadena Calif guided missile test sets. Prop No NOrd-132-56. NOrd-17400 $404 406

Columbia Research and Development Corp., Columbus Ohio improve the safety and reliability of the 30 mm aircraft gun MK 4/30 mm feed mechanism MK 2/30 mm ammunition link MK 1 weapon system. NOrd 17127 $132 920

Hughes Tool Co., Aircraft Div Culver City Calif improve safety and reliability of the 30 mm aircraft gun and MK 4/0 ammunition link Mk 1 weapon system. NOrd-17128 $166 740

Bulova Research and development laboratories, Woodside N Y Research and development in connection with guided missile fuzes. NOrd-17030 $312 370

DISTRICT PUBLIC WORKS OFFICES, Sixth Naval District Building 13 U S Naval Base, Charleston S C

T R Bourne & Associates and Reynolds Smith & Hills, P O Box 4817 Jacksonville, Fla. architectural-engineering services for site feasibility study for the proposed Naval Air Station, Sixth Naval District. NBy-10220 $97 390

HAAS Register, Cummings & Holehtu-

sau, 115 Park St., HAAS Bldg., Jacksonville, Fla., architectural engineering services for the preparation of plans and specifications for interim facilities, Naval Air Station, Sanford, Fla. NBy 10222, $66,920.

Nat G. Harrison Jr. and Associates, 5137 N. E. 2nd Ave., Miami, Fla., utilities and structures at Walker Cay, Carter Cay and San Salvadore Island, B.W.I., for the AF Missile Test Center Offshore facilities. (NBy-6474) job, $434,000.

DISTRICT PUBLIC WORKS OFFICE, Eleventh Naval District, San Diego 32, Calif.

R. F. Fisharth and S. B. Alpes, 21235 Dolan Street, Torrance, Cal. Procurement and installation of electrical generating equipment at San Nicolas Island, Naval Air Missile Test Center, Point Mugu, Cal. Contract NBy 5405 (IFB 5465/56B) job, $249,860.

U. S. NAVY PURCHASING OFFICE, 1206 S. Santee St., Los Angeles 15, Calif., Jan. 21, 1957

Rustler Douglas Aluminum Corp., 3616 Katona Ave., Riverside, Calif., necessary labor and material to manufacture 5.00 target rocket. N123(70530)11862A (Sch. 73170-12-14-56), job, $78,422.

Atlantic Research Corp., 812 N. Fairfax St., Alexandria, Va., personnel, facilities, techniques and materials to design, manufacture and deliver fifty end burning grains and twenty incremental grain assays of arcite propellant. N123(60530) 11811A (Sch. 72674-10-24-56), job, $60,660.

PHILADELPHIA ORDNANCE DIST., 128 N. Broad St., Philadelphia 2, Pa.

Western Electric Co., Burlington, N. C., Nike spare parts & components, $126,553; $21,715; $1,269,606; $38,380; $41,004; $48,160; $1,173,710.

Western Elec. Co., Inc., Burlington, N. C., Nike spare parts & Components, $134,086.

Kennedy Van Saun Mfg. & Eng. Corp., Danville, Pa., shell for cartridge, 81MM HE, M-362, 425,466 ea., $846,800.

U. S. NAVAL TRAINING DEVICE CENTER, Port Washington, N. Y.

Melpar, Inc., Falls Church, Va., Design, development and construction of H-37A Helicopter Operational Flight Simulator Trainer. Contract N61436 31 lot, $1,953,981.

NAVY PURCHASING OFFICE, 4th & Independence Ave. SW, Washington, D. C.

Airesearch Mfg. Co. of Arizona, 402 S. 36th St., Phoenix, Ariz., Air turbine starters model A-21 and QAD Disconnect and related parts. (N600(A)42411)(IFB600-1646-56) 542 ea., $340,080.

Bendix Aviation Corp., 711 Seward Ave., Utica, N. Y., Air turbine starter model A-14 and QAD disconnect and related parts (N600(A)42419) (IFB600-1644-56) 311 ea., $223,003.

Airesearch Mfg. Co. of Arizona, 402 S. 36th St., Phoenix, Ariz., Air turbine starter Model A-21 and QAD disconnect and related parts (N601(A)42405) (IFB600-1654-56) 530 ea., $544,968.

Jack and Heintz, Inc., 17666 Broadway, Cleveland, Ohio, starter model E-3 (N600(A)12029) (IFB 600-1770-56) 465 ea., $229,242.

NAVY DEPT., Bureau of Ships, Washington 25, D. C.

Boeing Airplane Co., 7755 E. Marginal Way, Seattle, Wash., conduct research required to evolve new designs for components for a 400 HP continuous rating gas turbine engine. Contract NObs-72211 (Inv. No. 350-31Q) $251,461.

Solar Aircraft Co., 2200 Pacific Highway, San Diego, Calif., gas turbine air supply units with special tools. Contract NObs 73114 (Inv. No. 550/526-46Q) 26 ea., $327,393.

DISTRICT PUBLIC WORKS OFFICE, Eighth Naval District, New Orleans, La.

F. B. Farrow Co., P. O. Box 13156, Dallas 20, Texas, Steam Jet Ejectors, Barometric Condensers and Related Facilities, Naval Ordnance Aerophysics Laboratory, Daingerfield, Texas. (IFB NBy-1126) $563,477.

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Manufacturers are busy broadening their research and development activities. They recognize that their competitive position depends on the ability to compete in the urgent quest for new basic scientific knowledge in such diverse fields as geophysics, aerothermodynamics, metallurgy, human factors and aerothermochemistry, etc. Because of the highly specialized sciences and technical fields concerned, manufacturers must often obtain research and development assistance from outside sources — government, university, scientific foundation, foreign and other manufacturers. In a sense, research and development has become a *unique commodity that is produced, bought and sold.*

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CAB Accident Investigation Report:

United C-54 Flies Off Course, Hits Peak

United Air Lines Flight 409, a Douglas C-54B DC, N 30062, struck Medicine Bow Peak, Wyoming, near its top at approximately 0726,[1] October 6, 1955. All of the occupants were killed and the aircraft was demolished.

HISTORY

Flight 409 originated at New York, New York on October 5, 1955, destination San Francisco, California with intermediate stops including Chicago, Illinois, Denver, Colorado and Salt Lake City, Utah. The trip to Denver was routine except for traffic delays caused principally by weather, and the flight arrived there at 0551 October 6 one hour and 11 minutes late. Routine crew changes were made at Chicago and Denver, the last crew consisting of Captain Clinton C. Cooke, Jr., First Officer Ralph D. Salisbury, Jr., and Stewardess Patricia D. Shuttleworth. No discrepancies were reported by the former crew and none were found at Denver. While at Denver the aircraft was refueled to a total of 1,000 gallons of gasoline.

Prior to departure Captain Cooke was briefed by the company's dispatcher on the en route weather based on both U. S. Weather Bureau sequence reports and forecasts and the company meteorologist's forecasts and analysis. Following this briefing the flight was dispatched to Salt Lake City via airways V-4, V-118, V-6, and V-32, to cruise at 10,000 feet and to fly in accordance with Visual Flight Rules (VFR). The estimated time en route was two hours and 33 minutes. The only obligatory reporting point along the route was Rock Springs, Wyoming.

The flight departed Denver at 0633, with 63 passengers, including two infants. At takeoff the gross weight of the aircraft was 64,147 pounds, 653 pounds under the allowable weight of 64,800 pounds, an error of 100 pounds in excess of the allowable rear baggage compartment weight[2] was made in loading. Flight 409 reported its time off to the company and this was the last known radio contact with the flight.

When the flight failed to report at Rock Springs at 0814, its estimated reporting time, repeated efforts were made to establish radio contact with it. These were unsuccessful and the company then declared an emergency. A widespread search was immediately coordinated by Air Search and Rescue which included the Wyoming Air National Guard, the Civil Air Patrol, and United Air Lines. At approximately 1140 the same day the wreckage was sighted near Medicine Bow Peak, 33 miles west of Laramie, Wyoming. The Laramie weather at 0728 was: Scattered clouds, 5,500 feet, visibility 40 miles, wind west-northwest 13 knots, snow showers of unknown intensity over the mountains.

INVESTIGATION

The aircraft struck the almost vertical rock cliff of the east slope of Medicine Bow Peak (elevation 12,005 feet) located in the Medicine Bow Mountains. The crash occurred at an elevation of 11,570 feet, 60 feet below the top of that portion of the mountain directly above it. Two large smudge marks were apparent on the face of the mountain. In these marks were four scars evenly spaced and in a horizontal line, the result of the engines and propellers of the aircraft striking the cliff.

At impact the aircraft disintegrated and the wreckage was strewn over a wide area. Some parts were thrown to the mountain top above the crash site, others rested on ledges at various levels, and the remainder fell to the slope below.

In order to be closer to the scene so that the recovery operation and investigation could be conducted expeditiously, a base camp was established on the mountainside at an elevation of 10,400 feet. Above the camp travel was extremely difficult up a talus slope to the base of the cliff. From there it was necessary to scale the almost vertical cliff a distance of 600 feet to reach the point of impact. Because of the rugged terrain, groups of experienced mountain climbers were formed in an effort to reach locations otherwise inaccessible. Removal of the bodies of the victims took several days because of the rugged terrain and snow conditions. While this was being accomplished investigation was considerably hampered by falling rocks dislodged by the climbers.

Dangerous Site

As the investigation continued the Board decided that working conditions were too dangerous for other than the experienced mountain climbers and therefore investigators who had at this time reached an elevation of 11,275 feet were not allowed to proceed further. At this elevation several large sections of the aircraft were found, including the empennage which had been broken from the fuselage just in front of the vertical fin.

Sufficient portions of the aircraft were identified to indicate that it was intact at the time of impact. This was substantiated by the fact that no portion of wreckage was found during an extensive air and ground search of the determined flight path. The empennage and portions of the fuselage and wings were studied.

The entire empennage section was severed aft of the passenger cabin near station 929. This section was generally intact and was wedged in an opening in the cliff. The left stabilizer and elevator were severely damaged but the right stabilizer and elevator received only minor damage. The fuselage forward of the empennage, including the cockpit, disintegrated at the time of impact. Only twisted and distorted portions of each were located. Examination of the control cables indicated tension type failures. The left windshield with windshield wiper attached was found, its frame twisted, and the glass shattered.

Parts Examination

No evidence was found in the examination of the recovered parts of the aircraft or its components to indicate that fire or structural failure had occurred prior to impact.

The four engines were located and examined. They were badly damaged but no evidence was found to indicate they were not functioning in a normal manner prior to impact.

All 12 propeller blades were accounted for; these were badly twisted and bent. Examination of the propeller blades and propeller hubs indicated that all four propellers were rotating at the time of impact.

Both large CO_2 bottles and one hand bottle were found. These were empty and their valves had been broken at impact.

Oxygen bottles were also recovered with valves attached. Laboratory tests showed that these bottles did not contain oxygen when examined and that there was no toxic contamination. A pilot's smoke mask was recovered but it was impossible to determine if it had been worn during the subject flight. The pilots' oxygen masks were not recovered.

Two cabin heaters were found. These were so damaged that an operational test could not be made. However, teardown inspection revealed nothing to indicate malfunctioning prior to impact.

Three watches and an aircraft clock were found and examination showed that the average time of their stoppage was 0726.

The radio and navigational equipment on board the aircraft was damaged in a manner which did not permit reliable readings to be made. All ground navigational facilities that could have been involved were checked as soon as possible after the accident and were found to be operating within tolerances.

A study of the maintenance records showed that this aircraft had been properly maintained in accordance with company procedures and Civil Air Regulations.

On October 6, 1955, at the time of the subject flight, a large high pressure area was centered over Idaho. This high pressure area was preceded by a cold front which, at the time of the accident, was located

[1] All times herein are mountain standard and based on the 24-hour clock; all altitudes are mean sea level and all miles are nautical.

[2] This minor error affecting the center of gravity of the aircraft had no bearing on the accident.

500 to 600 miles to the southeast. This resulted in the weather being generally fair with some scattered clouds over the lower terrain of the planned route Denver to Salt Lake City.

However, off the airway broken to overcast cloud conditions, accompanied by light snow showers, were present over the high mountain peaks and ridges. From the available information it is concluded that the free air wind at the 12,000 foot level in the Laramie, Wyoming, Medicine Bow Mountain range was from 330 degrees at 30 to 40 knots. The velocity of the wind in the immediate vicinity of Medicine Bow Peak can only be estimated; however, it is believed that because of added terrain effect it could have been increased to 50 to 60 knots.

This would have resulted in downdrafts and turbulence being present near the lee slope and probably for a distance of 10 to 15 miles away from the mountain on that side.

Considerable thought and study were given to the possible existence of a mountain wave* condition in that area. Some of the factors associated with the formation of a mountain wave were present, however a number of the factors considered vitally important were not present and it is doubtful if such a wave did exist at the time of the accident.

A pilot flying a small aircraft on October 6 from Cheyenne, Wyoming, to Reno, Nevada, passed Medicine Bow Peak approximately 22 miles to the east and north within a few minutes of the time the accident occurred. He described the weather conditions as follows: "... the haze was thick especially to the north.

"However, the visibility toward the mountains was very good. The tops of the mountains were hidden by white cumulus clouds whose tops I estimated to be about 13,000 feet. I was especially interested in the tops at the time as I had considered before leaving Cheyenne using the Victor 4† airway but was warned by the lady in the Weather Bureau that I could expect heavy turbulence and strong downdrafts over the mountain."

Witnesses

During the investigation a number of persons believed to have seen the aircraft prior to its striking the cliff were interviewed. None of these witnesses could positively identify the aircraft they saw as a United Air Lines C-54; however, they said the airplane was large and had four engines. All of the witnesses who were in the general vicinity of Medicine Bow Peak agreed that this airplane was silver in color and was flying in a northwesterly direction toward the peak.

Three witnesses, who were at a logging camp located about 10 air miles southeast from the crash site, said that the airplane did not appear to be turning but that its right wing was slightly down. They estimated its altitude to be about 10,000 feet by the known elevation of the camp (9,600 feet), the approximate height of the nearby trees (60-75 feet), and that the aircraft did not appear to be higher than 500 to 600 ft.

These witnesses saw the airplane (for only a short time) several hundred yards away and through a clearing in the trees. The aircraft was then flying immediately below the clouds and intermittently flew either into or behind clouds, momentarily obstructing their view of it.

Noise Like Cannon

One of these witnesses said he believed one propeller was not rotating; others said they believed all of the engines were operating in a normal manner. One witness testified that a few minutes after the airplane passed from his view he heard a noise in the distance which sounded like a cannon firing or a mining blast. He did not at that time associate the noise heard with the airplane he had seen.

In the vicinity of the camp at the time were low rolling clouds and the visibility was somewhat hazy owing to dusting snow; the sun could not be seen. Medicine Bow Peak could not be seen from the camp because of terrain obstructions. A check was made of all available sources, both civil and military, to determine if another airplane of that size could have been flying in that vicinity at that approximate time; none was found.

As a result of information obtained from the witnesses, a probable flight path was constructed. This flight path projected from the accident site on a magnetic heading of 120 degrees, covered a distance of approximately 23 miles. An extension of this flight path to the southeast crosses the planned route in the vicinity of Ft. Collins, Colorado, and to the northwest again crosses it near Rawlins, Wyoming.

Medicine Bow Peak is located about 124 miles north-northwest of Stapleton Field, Denver, and is 33 miles west of Laramie. A few miles south of the peak the mountains can be crossed at an altitude of 10,000 feet and once beyond them the North Platte River valley can be followed to the vicinity of Rawlins (Sinclair radio).

As previously stated, the company Flight Plan and Dispatch Release for the subject flight specified a course to be flown VFR over airways V-4 Denver to Laramie, V-118 to Rock River radio, V-6 to Fort Bridger, Wyoming, and V-32 to Salt Lake City; weather analysis, weather forecasts and sequence reports were attached. This document was signed by both the dispatcher on duty and Captain Cooke.

The "Weather Analysis" portion of the release was signed by Captain Cooke as having been prepared by him. Under the subsection entitled "Mass Weather" was the following: "High pressure area, Great Basin moving slowly eastward, scattered occasionally broken and cumulus clouds along the east slope of the Rockies based above flight level. Air slightly rough."

A review of all documents pertaining to

*Under certain atmospheric conditions, a strong windflow perpendicular to a mountain ridge will produce a wave-type structure on the lee side similar to the waves produced downstream from fast flowing water over a submerged rock. These waves develop on a tremendous scale, often two or more times the height of the mountain barrier which produced them. Violent downdrafts, updrafts and turbulence occur in the wave when it is well developed. When moisture content of the air involved is favorable, characteristic cloud patterns develop in the wave.

†Victor 4 Airway lies just north of Medicine Bow Peak and extends between Laramie radio and Cherokee radio on a magnetic bearing of 273 degrees.

SAFETY

the dispatch and release of the aircraft at Denver together with the testimony of company personnel indicates that other than the error in loading the rear baggage compartment the dispatch was made in accordance with United Air Lines' established procedure. Company officials testified that under VFR conditions any deviation from the prescribed route either in altitude or direction is the captain's responsibility but must be coordinated between the captain and dispatcher. Captain Cooke did not advise the dispatcher of any intended deviation from the flight plan.

The Company Flight Operations Manual re Maximum Levels Unpressurized Cabins states "Flight will normally be conducted at levels not to exceed 12,000 feet above sea level." Another company rule is "In VFR conditions flights will check and follow the radio navigational courses which define the airway." These and other company rules governing VFR-IFR flight represent a company policy which is patterned for the safety and comfort of its passengers.

Captain Cooke was qualified to fly the route involved in August 1951 and had flown it 45 times in the year preceding the accident. According to his superiors in the company he had never been known to deviate from a planned route without advising the dispatcher.

In accordance with the Board's policy of keeping accident investigations open for consideration of new evidence and since incapacitation of the crew was a possibility that could neither be supported nor negated by existing evidence it was decided to return to the accident scene to continue the investigation. This could not be done for an appreciable time because of deep snow on the mountain. However prior to the decision to continue the investigation the wreckage had been released to the carrier and because it was believed to be a hazard to the public welfare an attempt was made to destroy and bury it—this was done by U S military ground and air forces.

Second Investigation

On August 27, 1956 a second investigation was begun. This working group headed by Board personnel included employes of United Air Lines and company pilots representing the Air Line Pilots Association. The investigation on the mountain took three days and many aircraft parts which had previously been examined were re-examined. Numerous components of the cockpit together with the fuselage nose section were found at an elevation of 11,390 feet on a rocky ledge. This wreckage was badly damaged by impact, and the ensuing fire.

Beneath a portion of the wreckage the cockpit combustion heater was found. It was mashed flat and was bent 90 degrees near its middle. The igniter plug, with its lead torn away, remained in place. All fuel and air controls were missing. The heater was brought back to Washington, D C, subsequent to the investigation and was delivered to the National Bureau of Standards for further examination. It was the Bureau's determination that all failures were apparently caused by mechanical damage.

It is possible that the mechanical damage referred to could have occurred on impact.

The No. 3 propeller hub found on the talus slope was further examined. Its dome shell was broken off and the piston was broken. The distributor valve was mashed in the end of the propeller shaft. All but three of the barrel bolts were broken and the barrel halves had separated approximately one inch. The barrel bolts were removed and the barrel halves separated in order to examine the dome position. The stop rings were in place and had been in position for a blade range of 24 degrees low pitch and 93 degrees full feathering. The dome piston position indicated a blade angle of approximately 31 degrees.

Because of the extensive impact damage to the propeller it was impossible to remove the rear barrel half from the propeller shaft. Parts of two spider shim plates and two brass shims were recovered. By matching the pieces of the shim plates an impact mark was determined which indicated an approximate blade angle of 38 degrees. Impact marks on the brass shims indicated approximate blade angles of 35 degrees.

A propeller governor was also located on the talus slope. It was determined from the model and serial numbers of this governor that it had been installed on the No. 4 engine. The drive shaft coupling was missing and the drive shaft housing was pushed inward at impact. The control pulley was broken from the head; the control shaft was intact. The control head was removed and installed on a serviceable governor.

This assembly was then placed on a governor test stand in order to check the rpm setting of the control head. This test revealed that the control head was positioned for 2,080 engine rpm which is within the normal cruising range for the subject aircraft and engine. Disassembly of the control head revealed a slight binding of the shaft due to impact. The counterbalance spring was intact with normal tension. Examination of the pilot valve and flyweight assemblies revealed no indications of operational distress. All this additional evidence concerning the propellers and their related systems substantiates the fact that all propellers were rotating at the time of impact.

ANALYSIS

Hazardous working conditions throughout the investigation of this accident made it difficult to examine adequately pertinent components of the aircraft, however, there are many known factors and the careful consideration of these is presented.

It is obvious from the established flight path that the aircraft deviated from the planned route a number of miles to the west of course. Although witnesses close to the scene of the accident were unable to positively identify the aircraft they saw, in the light of known facts it is reasonable to assume that the aircraft seen was the United C-54. Therefore, it can be concluded that considering the weather conditions and mountainous terrain the aircraft was flying at a dangerously low altitude at that time.

A UAL captain testified that it was normal procedure for UAL pilots during a climbout from Denver under VFR conditions to fly several miles east of the airway. He said this was done to avoid incoming low-flying aircraft which usually begin their letdown near Fort Collins, Colorado. This

fact was considered in computing probable flight data for Flight 409, from which it was determined that the flight reached its cruising altitude of 10,000 feet approximately 25 miles north of Denver From this point a heading of approximately 315 degrees magnetic would have been required to fly to Laramie From this same location a magnetic heading of 300 degrees would have been necessary to fly directly toward Medicine Bow Peak.

An extension in both directions of the known flight path indicates that either a shortcut was being attempted when the accident occurred or that the crew was incapacitated and the aircraft was flying without assistance

In considering the first premise it is difficult to understand how a pilot of Captain Cooke's experience would deliberately attempt a shortcut and even if he did why he would have flown at such a low altitude over hazardous terrain It is true that the flight was an hour and 11 minutes late however the time saved by taking a shortcut would have been inconsequential Prior to departing Denver the crew had full knowledge through weather reports that scud and turbulence were present in the mountainous areas and that snow squalls were expected to occur

Knowing this, and the fact that the weather along the planned route was good makes a shortcut even more incomprehensible also Captain Cooke was fully aware of the hazards accompanying mountain flying There is also the fact that the visibility was 40 miles that morning and it is evident that the clouds covering the mountains could have been seen from a considerable distance

To cross the mountains over Medicine Bow Peak safely an altitude of approximately 14,000 feet would be necessary Such an altitude and its attendant passenger discomfort in a nonpressurized aircraft would normally be avoided Finally to deviate from course in this manner, the captain would have been breaking rigid company rules and his record indicated that he had never been known to do so

Crew Incapacitation

Considering the navigation equipment on board the aircraft, the fact that all pertinent ground facilities were functioning in a normal manner the pilot's knowledge of the terrain and the good visibility prevailing that day it does not seem possible that a navigational error of any magnitude could have been made

The matter of crew incapacitation cannot be completely ruled out The cockpit heater when examined did not indicate any burn-outs prior to impact which could cause poisonous gasses to enter the cockpit however the exhaust manifold was badly damaged and some of it was not recovered Should this portion of the heater have been defective dangerous gasses could have entered the nosewheel well and could have been transported from there to the cockpit by means of the ground blower However the ground blower is normally turned off before the aircraft becomes airborne and is never turned on in the air unless there is a blockage of the nose ram airscoop Although the incapacitation of persons in the cockpit in this manner appears unlikely, it nevertheless cannot be completely discounted Also it is possible that the crew may have become incapacitated by some other means One possible fact points strongly toward this not being true—when the aircraft was only four minutes from Medicine Bow Peak it was flying at an altitude of approximately 10,000 feet

Since the aircraft struck the mountain at an altitude of 11 570 feet it must have climbed about 1,500 feet in approximately four minutes, and it appears likely that some positive action on the part of the crew was necessary to accomplish the climb

In consideration of the above facts the Board is of the opinion that there is insufficient evidence to establish that the deviation from the planned route was due to incapacitation of the crew, errors in navigation or malfunctioning of the aircraft or any of its components but rather that the pilot deviated from the planned course for reasons unknown

FINDINGS

On the basis of all available evidence the Board finds that

1 The carrier the aircraft, and the crew were properly certificated

2 The gross takeoff weight was within the allowable limits at the time of takeoff, improper distribution of the load was of such minor extent it was not a factor

3 The flight plan was properly prepared by the crew

4 The weather along the prescribed route was good and the aircraft could have been flown safely at an altitude of 10,000 feet

5 The pilot deviated from the planned route

6 The aircraft was observed flying in and out of clouds at an approximate altitude of 10,000 feet 10 miles southeast of the accident scene and 21 miles west of the prescribed course

7 The aircraft struck the mountain peak at an altitude of 11 570 feet

8 Examination of the recovered sections of the aircraft failed to indicate any fire, structural failure, or malfunctioning of the aircraft or its components prior to impact

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the action of the pilot in deviating from the planned route for reasons unknown

By The Civil Aeronautics Board

James R Durfee
Chan Gurney
Harmar D Denny
G Joseph Minetti

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at 1000 October 6, 1955 An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended A public hearing was ordered by the Board and was held in Denver, Colorado on November 14 and 15 1955 This hearing was reconvened January 9 1957, in Washington D C

Air Carrier

United Air Lines, Inc is a scheduled air carrier incorporated in the State of Delaware with its principal offices in Chicago Illinois It operates under currently effective certif

icates of public convenience and necessity issued by the Civil Aeronautics Board and scheduled operating certificates issued by the Civil Aeronautics Administration These certificates authorize the company to transport by air persons, property and mail between various points in the United States, including the route New York, New York, to San Francisco, California

Captain Clinton C Cooke, Jr, age 35, held a currently effective airman certificate with airline transport rating and an appropriate rating for the subject aircraft Captain Cooke was employed by United Air Lines on January 13 1944 He had a total of 9,807 pilot hours of which 2,289 hours were in the type equipment involved His last physical examination was on June 22, 1955, and his last route check was on June 20, 1955

First Officer Ralph D Salisbury, Jr, age 33 held a currently effective airman certificate with commercial rating He was employed by United Air Lines on May 21 1952 He had a total of 2,418 pilot hours of which 343 hours were in the type of equipment involved His last physical examination was on August 23, 1955, and his last route check was on November 12, 1953

Stewardess Patricia D Shuttleworth age 21, was employed by the company in February 1955 She graduated from the Stewardess School in Cheyenne on March 7 1955 and was assigned to Salt Lake City April 13 1955 Her performance and evaluation records as a stewardess reflect excellent grades

N 30062, a Douglas C-54B-DC, manufacturer's serial number 18389, was manufactured in 1943 and had a total time of 28,755 hours with 1,289 hours since the last overhaul It was currently certificated by the Civil Aeronautics Administration The aircraft was equipped with Pratt and Whitney model R2000-11 engines and Hamilton Standard model 23E50 propellers with model 6507 blades Time since major overhaul on the four engines was within approved limits

BOAC Averts Strike Of Flight Engineers

London—Crews of British Overseas Airways Corp Britannias began their first scheduled runs under a temporary compromise agreement in a lengthy dispute concerning the status of the flight engineer in the turboprop aircraft

Instead of the engineer's station BOAC has provided a jump seat behind and between the pilot and co-pilot's seats designed for an engineer's watch station or as a supernumerary crew seat

Merchant Navy and Air Line Officers Assn, which represents the engineers, opposes performance of more than one function by the same officer of an aircraft British Air Line Pilots Assn believes engineer duties are too few aboard the Britannia for the engineer to make a significant contribution to the work load

New working party was set up to clarify the situation, with recourse to the National Joint Council

WHO'S WHERE

(*Continued from page 23*)

Changes

Frank R Carver, head radar development department, and **E L Herman** head radar systems department Airborne Systems Laboratories Hughes Aircraft Co Culver City, Calif Also **John C Bailey** head scientific and general recruitment, Systems Development Laboratories

James O Gregory, a transport pilot for the Los Angeles Division North American Aviation Inc., Los Angeles Calif

H Fisk Tarbox, manager newly created Aviation Sales Department Mobil Overseas Oil Co, affiliate of Socony Mobile Oil Co

Alfred Schaff Jr, manager test and field service Aerojet General Corp's Solid Rocket Plant Sacramento, Calif

Lorne W Frame, public relations manager, Orenda Engines Limited Malton Ontario, Canada

Gen Roger M Ramey (USAF ret), a consultant with Radioplane Co subsidiary of Northrop Aircraft Inc Van Nuys Calif

H Richard Alexander western regional customer relations manager (Manhattan Beach Calif) Stratos division of Fairchild Engine & Airplane Corp Bay Shore, N Y

Clare E Burkalow, associate manager-advanced engineering division Lear Inc Grand Rapids Mich

Frank J Beach, director airfreight traffic American Airlines Inc Also **John W Colthar**, director-schedule development **Alfred E. Deshell**, manager passenger tariffs **Arthur M. Morton** manager schedules **Mark Forrester**, manager airfreight tariffs

Oliver Judd, station ground services manager (Portland Ore) United Air Lines Inc Mr Judd succeeds **E S Maroney**, deceased

Frank F Davis domestic sales manager, California Division, Lockheed Aircraft Corp, Burbank Calif

G Norris Shaw, senior military liaison engineer Temco Aircraft Corp, Dallas, Tex

Robert M Hawley, director sales and customer relations, Weapon Systems Division Bell Aircraft Corp Buffalo N Y

William F Callejo, manager properties Slick Airways Inc Also **James M Mask**, director purchasing

Howe H Hopkins, chief engineer Air-cooled Motors Inc, Syracuse N Y

Dr Donald M Allison, Jr, assistant manager military products, Radio Division, Bendix Aviation Corp., Baltimore Md

J W Stack, director sales and contracts (Milwaukee plants) AC Spark Plug Division General Motors Corp Flint Mich

W J Rutherford, aviation sales manager, General Logistics Pasadena, Calif

William G Alexander, chief engineer, Stromberg-Carlson a Division of General Dynamics Corp San Diego, Calif

R W Powell, assistant division manager Avionics Division Aerojet General Corp Azusa, Calif **B J Gastineau** succeeds Mr Powell as chief engineer

George E Beringer, general manager aircraft products section Bendix Products Division, Bendix Aviation Corp South Bend, Ind Also **Richey W Whitesell**, administrative assistant to the general manager

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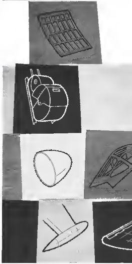

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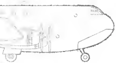

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HERE YOU SEE some of the major components now being supplied by Goodyear to major aircraft manufacturers. Goodyear engineers had a hand in virtually all of them.

Helping to outfit these winged powerhouses is just one of the exciting activities at Goodyear Aircraft these days. Important parts are being built for guided missiles — there are stimulating developments in electronics, radar structures, plastics, metals and countless other projects.

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If you have an eye to the future — and it's focused on the sky — a rewarding career can be yours at Goodyear Aircraft. Salaries and benefits are liberal, of course. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

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When there are many applicants for a single position it frequently happens that the only letters acknowledged are those of the most promising candidates. Others may not receive any indication that their letters have even been received by a prospective employer much less given consideration. These men often become discouraged, will not respond to future advertisements, and sometimes question their bona fide character.

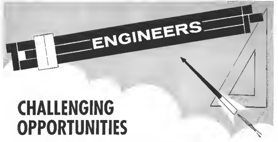
Every advertisement printed in the Employment Opportunities Section is duly authorized.

It will help to keep our readers interested in this advertising if you will acknowledge every application received, even if you merely return the letters of unsuccessful applicants with "Position filled, thank you" written or stamped on them.

We suggest this in a spirit of cooperation between employers and the men replying to Employment Opportunity advertisements

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.



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The men hired will enjoy working with some of the top men in the field and with the finest test, research and development facilities. GM's long-standing policy of decentralization creates individual opportunity and recognition.

Why not send us full facts about your education, work background, etc.
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GENERAL MOTORS CORPORATION
MILWAUKEE 2, WIS. FLINT 2, MICH.

ENGINEERS-SCIENTISTS: TEMPERATURES TWICE AS HOT AS SUN'S SURFACE NOW PRODUCED AT G.E.'S AEROSCIENCE LAB

New "Water Arc" Advances Nose Cone Technology at Missile & Ordnance Systems Department of General Electric

When MOSD became prime contractor for ICBM Nose Cone development, engineers and scientists here were faced with the necessity of creating not only new systems concepts, new components, new materials and new fabrication techniques, but also the *very tools and facilities to evaluate them.*

Meteors may melt on entering the earth's atmosphere, but the relatively thin-skinned nose cone must come through in full functional order. To test out heat-resistant materials capable of withstanding re-entry temperatures, a new instrument was devised under the direction of the research staff of MOSD.

... the WATER-STABILIZED ARC

How does the new water arc differ from the conventional electric arc? It is controlled—or stabilized—by a whirling blanket of water, which produces a "squeezing" effect, forcing the arc into the shape of a column. By causing a great amount of electrical current to flow across the column, extreme temperatures may be maintained continuously, subject only to the limitations of available power.

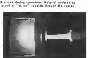
Valuable experiments are now being conducted at MOSD's Aeroscience Laboratory with the stabilized water arc. The most advanced heat-resistant materials are subjected to temperatures as high as 25,560° F—more than twice the heat of the sun's surface.

OTHER WAYS OF CREATING HYPERSONIC ENVIRONMENT AT MOSD

G.E. has built the largest, most powerful Shock Tunnel in the country in Philadelphia. Here free flight conditions in the order of Mach 20 can be matched. MOSD also utilizes a high power Centrifuge to test behavior of electromechanical and structural components under gravity loads up to 100 G's.

STABILIZED WATER ARC and G.E. designed TUNNEL shown during operation. Material undergoing test is held in front of the arc orifice by means of a rod or "sting" running through the tunnel.

3000 KW used in operating the stabilized arc and evacuation tunnel. (Shown idle.) Has ½" nozzle diameter. Present plans call for construction of a 3" diameter model, requiring 60,000 KW for operation.



View of fluid stabilized arc in operation. The liquid revolving inside the glass or plastic cylinder flowing at high velocity offers insulation as well as the material of which the plastic beam is composed.

OPENINGS FOR MEN WHO CAN EXPLORE NEW TECHNICAL AREAS

Engineers and scientists find an ideal research environment at MOSD. They work in small groups on problems of prime scientific interest—in close contact with managers and top specialists.

Located in downtown Philadelphia, adjacent to University of Pennsylvania and Drexel Institute, it is easy to take advantage of G.E.'s Tuition Refund Plan for graduate study.

EXCEPTIONAL GROWTH OPPORTUNITIES

Organized only in '56, MOSD has been growing phenomenally, and continued expansion is scheduled for '57. This expansion creates many opportunities to rise to positions of higher responsibility and income level. All of the managers of technical groups are themselves engineers or scientists and the majority have come up from within this or other departments of General Electric.

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If you are a Graduate Engineer or Scientist and have experience in these or related fields:

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... send us your resume or, if you prefer, write us for a convenient application form.

Your resume will be carefully reviewed by the MANAGERS of our various technical components. If qualified, you will be invited to visit our offices and discuss the work we are doing directly with the managers with whom you would be working. All communications will be entirely confidential.

Mr. John Watt, Professional Placement, Room 598]

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GENERAL ELECTRIC

1617 Pennsylvania Avenue, 17th floor, Philadelphia 3, Pennsylvania

ENGINEERS AND SCIENTISTS: EE's, ME's, Physicists.

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number 1 of a series of six

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and **HMEE HAS IT** *within these areas, offering assignments in the design and development of* — RECEIVERS • GEAR TRAINS • COMPUTER LOGIC • SERVOS • TRANSMITTERS • ANTENNA PEDESTALS • ANTENNAS • PULSE CIRCUIT TECHNIQUES • POWER SUPPLIES • CHASSIS AND CABINETS • TRANSISTORIZED CIRCUITS • RF COMPONENTS

What's more, **HMEE HAS IT** *in such additional assignments as* — HUMAN ENGINEERING • SYSTEMS ANALYSIS AND INTEGRATION • FIELD TEST PLANNING AND PROCEDURES • DATA REDUCTION AND ANALYSIS • COMPUTER PROGRAMMING • STANDARDS ENGINEERING

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And remember, variety is only one advantage we have to offer. Along with this growth opportunity, there's the proven, long-range stability to be found here (after all, we're a part of General Electric!) the educational opportunities of our 100% Tuition Refund Plan for advanced study at Syracuse University ... and many family benefits as well.

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Write in complete confidence to: Mr. George B. Callender, Dept. 62P

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Former Navel Aviator DC-3, D-18 Command time Overseas airline exper. ATR 6000 Hrs. New large corp [illegible] Diversified sales background 35 married 2 children Seeks [illegible]. PW-1911 Aviation Week

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This is a particularly favorable time for you to join this rapidly growing Engineering Department. Facilities include 16 completely equipped laboratories. A new air-conditioned engineering building will soon be completed.

The Columbus Division has prime responsibility for all North American's aircraft projects for the Navy—from concept through flight. Fine career opportunities for good men are available now. You should investigate immediately.

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Aerodynamicists, Thermodynamicists, Dynamicists, Stress Engineers, Structural Test Engineers, Flight Test Engineers, Mechanical and Structural Designers, Electrical and Electronic Engineers, Wind Tunnel Model Designers and Builders, Power Plant Engineers, Research and Development Engineers, Weight Engineers

Now is the time to act. Write: Mr. J. H. Papin, Personnel Manager, Dept. 56W4, North American's Columbus Division, Columbus 16, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, APRIL 22, 1957

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Towing Winch

It has taken me this long to come down out of the clouds about the very fine treatment you gave Claude Witze's excellent story on the H-21 towing demonstration (AW, March 25, p. 64-65). Everybody here was just as pleased as they could be with the picture layout and the text treatment you gave us. Our sincere thanks and gratitude to all of you.

There is only one sad note in connection with this story, and that is undoubtedly our fault. The story says that the electric winch that was used for the towing was Vertol designed. Charlie Wendt, president of All American Engineering, has called my attention to the fact that this was actually an AAE Model 80 winch. And because AAE's winch was a key factor in the success of the towing project, I want to set the record straight with you.

Edward J. Doherty
Assistant to the President
Vertol Aircraft Corp.
Morton, Pa.

Amplification

I should like to congratulate you on the technical accuracy of the article on the Bell Aircraft Corporation Automatic Carrier Landing System that appeared in the March 4 issue (p. 32-33) of Aviation Week.

One point, however, should be further amplified.

The Bendix P-1 autopilot mentioned in your article was used in the early flight test phase of the system. Later tests were conducted with a Douglas F3D using the Minneapolis-Honeywell MH-19 autopilot. We have also landed successfully a North American F-86 using a Lear L-5 autopilot, a Cessna 310 with a Lear L-2 autopilot, a Convair 340 with a Sperry A-12 autopilot and a F-94C using a Westinghouse W3A autopilot.

I should also like to thank you for mentioning the names of project personnel in your article. Bell Aircraft Corporation, as a matter of policy, feels that corporate successes should reflect credit upon the individuals responsible for them.

Robert G. Sellers
Sales Mgr., Avionics Div.
Bell Aircraft Corp.
Buffalo, N. Y.

F-105 Vs. F-107

There is a news item about the F-105 and F-107 competition in the March 11 issue (p. 25) of Aviation Week which says the F-105 holds a speed advantage and the F-107 has more range and payload. I believe this is an error in numbers. The F-107 is reported to be the faster of the two airplanes and the F-105 has the favorable margin on range and payload.

The competition between the F-105 and the F-107 is more interesting if a comparison is made between their predecessors, the F-84 and the F-86. In the Korean War most of the aerial combat was done by three good airplanes—the MiG-15 lightweight fighter, the F-84 fighter-bomber, and the F-86 fighter. The short range MiG-15 had a high rate of climb and was very maneuverable especially at high altitude. The F-84 was no match for the MiG-15 in aerial combat and the MiG-15 was a poor fighter-bomber with its short range and small payload.

The F-86 was both a fighter and a fighter-bomber. As a fighter its kill ratio of about 15 to 1 over the MiG-15 may never be equaled or exceeded. The F-86's record as a fighter-bomber is also impressive. It held the world's speed record for several years which gave it the ability to make an unescorted speed run to the target, drop its bombs and fight its way out against the attacking MiG-15's. The dual mission capability of the F-86 could not be equaled by the MiG-15, the F-84 or any fighter in the world at that time. This designed-in versatility made the F-86 Sabre jet the world's greatest deterrent to more "little wars" like the Korean War.

Today in the near Mach 2 speed range there is an identical situation of three great airplanes.

They are the Russian MiG-21 lightweight fighter, the F-105 fighter-bomber, and the F-107 fighter. All three are good airplanes but the F-107 is the only one that can do the job of the other two fighter airplanes.

The Red Air Force will gain air superiority both in quality and quantity unless we build more fighters to combat their MiG-21 lightweight fighter. Even a streamlined atomic army with mobile missile launchers can not defend itself against superior airpower. The USAF has two fighters that could combat the MiG-21. They are the F-104 lightweight fighter and the F-107 fighter. The F-104 is the only one in production. Unofficial reports about the F-107 indicate that it is heavier, has a longer range, can lift a bigger payload and costs more than the F-104. This was exactly the basic difference between the F-86 Sabre jet and the MiG-15 before the Korean War. The Korean War brought out the other differences that made the F-86 the most economical deterrent to the "little wars."

LeRoy F. Iverson
3524 Elm Ave.
Manhattan Beach, Calif.

Misunderstanding

In the interest of accuracy, both in statements and instruments, I'm taking this means of correcting some apparent misunderstandings as expressed in the letter of your correspondents Messrs. Hobley and Baylis of the Canadian Aviation Electronics Limited, which you published in the March 4 issue of Aviation Week (p. 142) in answer to a letter of mine which appeared in the Nov. 26, 1956 issue (p. 122).

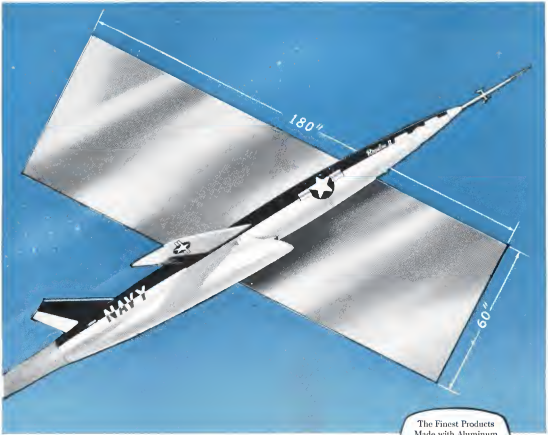
In studying the description of the Kollsman Integrated Flight Instrument System as it appeared in the March 5, 1956 issue of Aviation Week, Messrs. Hobley and Baylis seem to have received the erroneous impression that the altitude information provided by the system was true altitude rather than pressure altitude. Furthermore, they apparently overlooked the statement in my letter in which I stated, ". . . this is a commercial development and the system was designed primarily for and in conjunction with the scheduled airlines. . . ." Naturally an instrument designed for this use would not be designed to measure true altitude since all commercial flying at least, is based on pressure altitudes.

In trying to arrive at what they thought might be the true accuracy of the equipment in question, they claim to have statistically added various factors which contribute to altimeter errors associated with conventional instruments. In so doing, they arrived at a combined possible error of 230 ft. at an altitude of 40,000 ft. Although the factors mentioned as contributing to altimeter errors may be correct for conventional (uncorrected) instruments, a feature of the Integrated Flight Instrument System—the scale error corrector—has been entirely overlooked. This component is designed to correct for the calibration error which, from a practical standpoint, leaves only the error introduced by hysteresis and the setting error. The diaphragm hysteresis factor loses its importance, because in airline operation the effect is almost negligible. The setting error is beyond the system to control. However, the factors affecting this are being attacked on several fronts.

In my earlier letter I made the claim that altitude information provided by the system would be accurate to within plus or minus 100 ft. at 40,000 ft. This figure included tolerances for both the static system and the instrument scale error correctors. However, since the static corrections are based on the assumption that the error (expressed in feet) is a function of angle of attack and Mach number, rather than the classical assumption which also includes altitude, and since in practice tolerances are established by making use of Mach number vs. altitude performance envelopes for particular aircraft to minimize the differences between the two assumptions, a tolerance of plus or minus 120 ft. may be experienced at 40,000 ft.

As for the statement concerning the variation in altimeter readings experienced by the eight F-80's at 36,000 ft., I'm sure Messrs. Hobley and Baylis have overlooked some of the reports on static system errors in military aircraft. Errors of plus or minus 1,200 ft. at 20,000 ft. have been accepted in production type aircraft and, in some cases, errors of 5,000 ft. at operating altitudes.

Everett H. Schroeder
Kollsman Instrument Corp.
Elmhurst, N. Y.



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